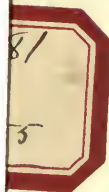


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THE IRRIGATION AGE.

VOL. VI.

CHICAGO, JANUARY, 1894.

No. 1.

THE PROGRESS OF WESTERN AMERICA.

"The Age" in 1894. The new form in which THE IRRIGATION AGE greets its readers this month explains its own advantages, the chief of which is convenience for handling, alike in the monthly part and the bound volume; it also furnishes better opportunities for departmental division, and for that gradual but steady expansion of size which the constant growth of the magazine demands. The new form is not strictly original. That distinguished success, the *Review of Reviews*, is the model to a considerable degree. Reference is made in the publisher's announcements in the advertising pages to another feature of the plans of THE AGE for 1894. The idea is indicated in the title of this department, "The Progress of Western America." Western America is plainly broader than the irrigation industry alone, though that industry must forever lie at the base of its civilization. But there are correlative industries, so intermingled and interwoven with the cultivation of the soil that it is impossible to say that any community or any class is interested in the progress of one line of activity and in no other. Communities are not independent, but interdependent. The essence of commerce is the exchange of products. The first concern of the farmer is to produce something to sell, but the second concern is for a market in which it may be sold. The producer is happiest when the consumer is nearest at hand. And the process by which the producer and the consumer shall be developed, side by side, must go on simultaneously and under a common impulse. This is true of all countries, but it is more perfectly true of Western America than of any other large division of the surface of the earth.

Diversified Industry in Arid America. Industry is most prosperous where it is most largely diversified. There are localities where diversification has come through the ingenuity of man. The arid region will owe the variety and symmetry of its industrial life to the extraordinary generosity of nature. The application of man's energy and faith alone is necessary to produce in the western half of the continent the most perfect civilization the world has ever seen. In Arid America the mining camp is generally the near neighbor of the agricultural valley. Water for power is usually found in connection with water for irrigation. Hence manufacturing and agriculture are the twin offspring of a common parentage. It is worth while to refer to a single example. Take the city of Ogden, at the northern end of Utah. It stands at the head of a fertile valley, closely cultivated by means of hundreds of small irrigated farms. In the moun-



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MAJOR J. W. POWELL.
Director of United States Geological Survey.

[NOTE TO SUBSCRIBERS.—A volume of THE AGE usually consists of six numbers, but the November AGE was designated as No. 7, Vol. V, thus constituting an extra number. This plan was adopted in order to start the new volume with the first month of the new year. The December issue was omitted in order to enable the publishers to perfect arrangements for bringing out the paper in its new form without getting hopelessly behind the date of publication. This issue is "January, 1894. Vol. VI, No. 1." All subscriptions will be advanced on our books one month. For instance, if a subscription is paid up to March it will not expire until April, so that the omission of the December issue will work no injustice. The same statement applies to advertisers.—PUBLISHERS.]

tains on one side of it is the prosperous mining camp of Park City, while the undeveloped possibilities of La Plata lie within easy reach in another direction. The water which comes from the canons to irrigate the valley is now about to be utilized for power to generate electricity, and this will turn the wheels of numerous industries, as well as supply the heat and light for stores, factories and dwellings. Ogden is not an unusual instance, except in the fact that it is further developed than most localities. Nature has provided the foundation of an industrial life which will be almost complete. The producer and the consumer have grown up side by side. They supplement each other at every step. Their interests are inextricably blended. They can no more be separated than the trunk, the leaf and the blossom of the tree.

A Distinctive Journal.

Is it possible to make a magazine, founded upon these conditions, which will become the distinctive journal of Western America? Three years of patient study convinces us that it is. Early readers will remember that the first few numbers of this periodical bore the title—THE IRRIGATION AGE AND WESTERN EMPIRE. The first conception of its scope was along these lines, but it was quickly discovered that the idea was too comprehensive for general appreciation at that time, and the sub-title was dropped, in order that nothing should interfere with the vigorous presentation of the irrigation idea. During the last few months public thought has rapidly shaped itself in conformity with the original conception of THE AGE. Projectors of irrigation enterprises now generally present the water power feature to the investing public. Electricity has come to the fore with prodigious strides, bringing in its train a flock of new industrial and social possibilities. It is now plain to the dullest imagination that the movement which renders habitable the deserts of Arid America necessarily awakens the latent possibilities of the water falls, the mine, the factory and the ideal conditions of social life. Everybody is beginning to see that all these things are web of one woof. And if they are all to be represented in their broader outlines in one periodical no other is so fit for the undertaking as THE IRRIGATION AGE, which already goes to every postoffice in the arid region, and is read in the counting rooms of eastern and British investors, and by a select public in every civilized country on earth, as the exponent of western aspirations. This, then, is the plan of THE AGE for 1894. It will be developed by a gradual process, and it will be true to its program.

*1894:
A Formative Period*

The year of 1894 will be the greatest year in the history of American irrigation. This may not be true in miles of ditches built, or number of acres reclaimed, but it will be true in a sense that is far beyond the matter of ditches and acres,

for irrigation is now a problem of institutions and a civilization. It involves the destinies of States, the future of National expansion, the outworking of the best possibilities of humanity itself. And it is in that aspect that 1894 will surpass all the years of the past—all the years of the future, too, perhaps—in what it will add to the history of American irrigation. For this will be known as the formative period. In the next few months, under the plan organized at Los Angeles, the men of seventeen States and Territories will be mapping out the irrigation policies of the future. The machinery of the State Commissions will soon be in full operation, and will be supplemented by a vigorous campaign, conducted by the National Executive Committee. The result of the year's work, if reasonable expectations are realized, will be the cementing of western public opinion behind a comprehensive national measure and the union of the various States upon an enlightened system of local laws. In doing this the men of the West will be laying the broad foundation of a civilization. This is the noble task set for the friends of Arid America in the year 1894.



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FRANCIS G. NEWLANDS.

Member of Congress from Nevada.

The First Plan Proposed.

The first plan of an arid land policy prepared for presentation to a State Commission comes from the fertile brain of L. M. Holt, and will be submitted to his colleagues of the California body. Briefly, its points are as follows:

1. There shall be created by national law a Department of Irrigation, the head of which shall be a Cabinet officer.
2. The States shall be given jurisdiction over all the arid public lands lying within their respective borders.
3. Every State shall create a permanent Irrigation Commission, of five members, one of whom shall be State Engineer.
4. Whenever it becomes desirable to reclaim a body of public lands, the State Commission shall devise plans for the work, which can only be put into operation after receiving the sanction of the national department.
5. This approval secured, the State shall issue its



VIEW ON SUNNYSIDE CANAL YAKIMA COUNTY, WASHINGTON.

bonds and proceed to construct the work, and then to open the lands for settlement, selling small farms with water rights for actual cost of reclamation, and the usual Government price per acre.

6. When half the land is occupied by actual settlers, the State shall form a district, under the Wright law, the bonds of which will redeem the State bonds, and thus in the end the control passes into the hands of the community.

Merits of the Plan. The Holt plan is only one of very many that will, no doubt, be presented to the State Commissions during the next few months. It is by the discussion of these various suggestions that a wise conclusion will be reached in the end. It is hardly likely that the plan will find general acceptance in its original form, because it departs so widely from the present method of reclaiming the arid lands. It is a long leap from private enterprise to this scheme of pure, unadulterated public control and operation, with no way station between. And yet this particular plan has some very strong features, the chief of which is the fact that it puts the responsi-

bility for progress squarely upon the Western States, while still recognizing the right of the nation to exercise a controlling influence both in legislation and administration, and thus to protect its interests. There are two stern facts to contend with, *i. e.* (1) that the nation must guard the great heritage of its people represented in the public lands, and (2) that if public works are to be built it must be done by the States, because it will be many years before the nation will think of spending money for such a purpose. We shall be fortunate indeed if, in the policy finally adopted, we steer between these two difficulties as skillfully as Mr. Holt has done in his plan. If this proposition could be enacted into law to-morrow, and then command a cordial support by the people, we believe it would prove to be an entirely workable policy. But not every idea that is meritorious is available, and it is easy to foresee where criticism will attack this plan. The Cabinet officer will not come very soon, but a Department of Irrigation, in which all of this class of work might be segregated under the Secretary of Agriculture, can very likely be obtained if strongly demanded by the West.

The Powell Speech.

The speech of Major John W. Powell, on the water supplies of the arid region, at the International Irrigation Congress was the one element of discord in that remarkable gathering. The offence given was summed up in the two following sentences, which are taken from the official record:

There is not water enough and can never be; a quantity of water can never be conserved sufficient to irrigate more than one-third of the land already owned by private individuals.

Not one more acre of land should be granted to individuals for irrigation purposes. If you irrigate the land yet remaining in the hands of the Government you have got to sacrifice some of the land remaining in the hands of individuals.

This statement from the director of the Geological Survey, following the platform declaration, that homes



HOWARD V. HINCKLEY.

Consulting Engineer of the Kansas Irrigation Association.

for millions can be made on the arid public domain, sounded very startling to the ears of men who expect to achieve so much for civilization by means of the organized irrigation movement. It seemed to be in direct and hopeless antagonism to the theory on which the platform had been erected, and the "Address to the People of the United States" promulgated. The speech was roundly denounced as a misstatement of the facts and a premeditated blow at a great cause, and perhaps by no one more roundly than by the editor of *THE AGE*, both on the floor of the Congress and in the pages of this journal. But is it possible for one to hold the views in the main expressed in the platform and still to welcome the Powell speech as the voice of conservatism, crying out in a waste of reckless enthusiasm? Is there,

after all, something valuable for the cause to be gained from a calm review of Major Powell's speech, especially with reference to particular localities? We can say for the men of the Irrigation Congress that they do not fear such a review of the speech. They are honest in their views, which are based on personal knowledge of their various States and Territories. There was not a particle of the element of personal enmity in their denunciation of the speech. On the contrary, Major Powell's reputation and position are such as naturally lead men to cultivate rather than repel his association with them.

Elwood Mead's Opinion.

These observations are prompted by letters received from several western men who are in thorough touch and sympathy with the writer on most subjects. For instance, there is Elwood Mead, State Engineer of Wyoming. No man is more jealous of the future of his State. None is more conclusively on record as having declared that his portion of Arid America has abundant water supplies and vast areas of arid public lands on which to utilize them. And yet he sends us a letter entitled, "A Defense of Major Powell," of which the following is the full text:

To the Editor of the Irrigation Age:

If one who confesses to holding perverse views on many questions may be permitted the privilege, I should like to offer a few words of protest against the extreme severity of the criticisms of the address of Major Powell at Los Angeles.

If the history of the irrigation movement has any lesson it is the need of liberality of judgment as to the views held on the proper disposition of the arid lands, and in any event, an honest expression of opinion should always be respected. The fact that a member of this convention had the temerity to suggest that the United States, considered as a land owner, has ceased to have any important interest in the arid land problem does not seem to me an adequate reason for an exception to this general rule.

The attitude of the convention, was however, that the paper was prepared in a spirit of unfriendliness to the west. Those of us who have long regarded "The Lands of the Arid Region" as outlining a model land system for that region will be slow to accept this view. The whole career of the Director of the Geological Survey is a continued refutation of that charge.

Nor do I regard the influence of this paper as being injurious to the west. The statement that the water supply is running low will not dry up a single stream. If it is a conservative view it is only a fair offset to the exaggerated estimate in which the convention so freely indulged. As between the dangers of the two there is no question.

Nothing is more needed than an adequate conception of the evils of over appropriation of streams. This applies to people living in the arid region, as well as to those who may become settlers or investors hereafter. The lack of proper preliminary investigation has already led to the absolute waste of thousands of dollars in the construction of ditches for which there was no water, and the unnecessary suffering and hardship of hundreds of settlers in the attempt to establish homes for which there is no support.

As the head of an administrative department, which has to deal with water right controversies from one year's end to another, I know how distressing are the losses and how bitter the controversies which grow out of the over appropriation of streams. Any one who calls attention to these things is worthy of commendation instead of censure.

The dangerous and insidious enemy of the settler, under Irrigation, is the one who predicts an indefinite unexplained increase in the present water supply and thus tempts settlers and investors to disregard or discount present conditions.

ELWOOD MEAD.

He will explain Himself. THE AGE has never been intolerant of differing opinions. It has never feared to share its space with those who wished to contend for convictions contrary to its own. The writer met Major Powell on the occasion of the Wichita convention, late in November, and had an opportunity to discuss the Los Angeles speech at length, and to explain to its author, in the serenity which pervades the smoking compartment of a Pullman sleeper after dinner, the grounds of the radical difference between the men of the Congress and himself. The circumstances of the latter meeting were plainly more favorable to calm discussion than was the floor of the convention on that turbulent afternoon, in the Grand Opera House at Los Angeles. The writer pointed out the offensive features of Major Powell's assertions, and received from him the explanation that his speech, when taken as a whole, would not bear the construction placed upon the sentences quoted; and furthermore, that when he had been assailed by stump speeches he replied in kind, rather than with the scientific statements which the convention was then in no mood to receive. The writer then invited the Major to prepare for THE AGE a scientific statement of the water supplies of the arid region, and to review, in connection with his article, papers on the same subject written by high authorities in the various States. This proposition was promptly accepted, and the results will be seen in a future issue.

Good Results Hoped for. Several good results may be expected to flow from this arrangement. In the first place if the views of Major Powell on the subject of water supplies and arid public lands are found to be practically in accord with those of the best authorities in the West—and he predicts that such will be the case—then we shall have an accepted standard from which to measure future possibilities. In the second place, we are sure to get the conservative side of the matter, and that is of importance in winning the confidence of capital. In the third place, if Major Powell, and the thousands represented by their delegates at Los Angeles who have differed with him, can arrive at common conclusions, then this splendidly equipped public servant will be brought into direct association with the majestic irrigation movement now sweeping through the West. The importance of this latter result it would be difficult to overestimate. For twenty-three years, with all the facilities which large public appropriations could command, Major Powell has been accumulating knowledge about the conditions of the arid West. During the first

seven months of 1894, the people of seventeen States and Territories, through the agency of the State Commissions, will be formulating the irrigation policies of the future. Now, if ever, is the time for them to avail themselves of the information gathered by the head of the Geological Survey. He has already appeared at the conventions in Kansas and Nebraska, and we have reason to believe he will accept an invitation from the National Executive Committee to appear at the series of meetings arranged for various States early in the year. If THE AGE can be instrumental in securing results so desirable as this, without sacrificing any of the principles which it holds to be vital, it will render a service of value to all concerned.

Gov. Waite's Wild Scheme. If Governor Waite has a place in history it will be as the John Brown of the silver fight. He is of the same radical mold as the hero of Harper's Ferry, but like that character his fame will be made or spoiled by events which follow his own rash acts. The exploit of John Brown was not more foolhardy than the course which the Governor of Colorado has followed in calling an extra session of his Legislature and seeking to provide for a mint and a currency independent of the Government at Washington. We do not doubt that Davis H. Waite is just as sincere as was John Brown, and that to his mind what he regards as the inevitable consequences of a single gold standard are just as revolting as was a system of human slavery to the soul of the mad Abolitionist. Nevertheless, the radical course of the Governor fails to command public respect outside of Colorado, and, apparently, inside of it as well. At the present moment the sober prospect is that the Governor will harm silver much more than he will help it by his pursuit of a course that is sure to bring ridiculous consequences, whether the Legislature accepts or refuses the proposition.

Colonists vs. Silver. If Governor Waite were determined to have an extra session he might have based it upon an idea that would promise substantial results. While the people of Colorado are awaiting that improvement in the silver market which is sure to come, they might well be devoting their attention to another and greater industry—agriculture—and to a systematic and effective scheme of colonization. Success in this direction would confer benefits upon their State quite equal to anything they would realize with the free coinage of silver. The more prosperous the mines of Colorado, the more prosperous will be the agricultural industry, but if that State had to choose between building 100 Greeleys or 100 Leadvilles during the next few years it would do well to build the Greeleys, because the latter would mean a far greater gain for civilization than the former. In saying this we do not depreciate the importance of the mines. The mining camp is the

best home market, and Colorado's hope of future greatness rests upon her varied resources. But it seems very plain that this is the time for studious attention to her irrigation possibilities.

*A Text
From
Depew.*

In his speech at the World's Fair on Manhattan Day, Chauncey M. Depew, speaking of the dangers which confront New York and Chicago, used these words: "The depopulation of the country and the overcrowding of the city present to each municipality problems of em-



✕ HON. MARTIN MOHLER.

Secretary of the Kansas State Board of Agriculture.

ployment and support which unsolved are dangerous to peace and property, and whose solutioners are not yet in sight. The genius of the American people for government will meet and overcome these perils, but at present they confine the energies of municipalities within their own limits." Mr. Depew belongs to a class and to a section which does not know that in the States and Territories of the arid West there is peace and happiness for the surplus population which menaces the prosperity of great eastern cities. He and his friends do not know the industrial history of Utah, of the Greeley colony in Colorado, of the irrigation belt of Southern California. Therefore they cannot realize how families can be more independent on small irrigated farms than is he in his home on Madison avenue. The development of a civilization which will teach men to produce from their own acres, under scientific cultivation by means of irrigation, everything they consume, is the solution of the problem which alarms Mr. Depew. The freest men who ever

walked the earth will live under the most charming social conditions that the human mind can conceive, where deserts now turn their blank faces to rainless skies. Nobody knows this better than the people of Colorado. Why are they not telling it to Mr. Depew and all the rest of their countrymen?

*Calamity
is
Opportunity.* The present year ought to be extremely successful in bringing colonization to the West. It is an historical fact that business depressions lend an impulse to the settlement of agricultural lands. An army of wholly or partially idle men, variously estimated at from 1,000,000 to 4,000,000, exists in this country to-day. Some of them have savings, but all of them must live somewhere and earn their bread by the sweat of their brows. Colorado has water and lands enough to support every one of them in reasonable luxury. She has the brains to map out an industrial scheme by which each one of them, on a farm no larger than forty acres at the maximum, could produce almost everything they consume, as well as a surplus for market. While we do not doubt the sincerity of Governor Waite in his present extraordinary course, it seems plain to us that he would accomplish more for his State and more for humanity if he had asked the Legislature, at its extra session, to provide means for opening to settlement homes for 1,000,000 people, and for putting into operation the agencies which would attract this new population, and show them the means of prosperity when they had arrived. His reply to this suggestion would doubtless be that it is useless to ask men to raise more products from the soil to be sold at the depreciated prices which the gold standard imposes, but the reply is that human appetite for food has not depreciated with silver, and that the man who is in a position to feed and clothe his family from the results of his own industry is as independent as any who lives by clipping coupons from Government bonds.

*A Coming
Idaho
Policy.*

Popular sentiment is clearly setting in the direction of the ownership by the people of all public plants and franchises in Western America. The difficulties surrounding the adoption of this policy, where every avenue of business is already occupied by private enterprise, with large vested interests, are by no means as formidable in the virgin field presented, in the main, by Arid America. While the boundless and varied resources of the new and greater West will always offer extraordinary opportunities for individual enterprise, it is also a fact that nowhere else in the world is there so favorable a ground for the out-working of what may be termed the Nationalist Idea. And it is bound to be tried. If it succeeds, it will thrive and grow; if it fails, it will disappear. At this moment Idaho, seems likely to play a leading part in this development. The movement there gains prominence from the fact that

it is advocated by Governor McConnell. THE AGE has not been favored with a full report of his recent speeches, but apparently he favors the application of the District law of California in Idaho. He wants future canals built by the State and administered by the people of the several localities they serve. Whether he favors the condemnation of existing works is not quite clear. The Caldwell *Tribune* has been vigorously fighting the system of water rentals as something which imposes a form of tenantry upon settlers. The movement is developing formidable proportions and will be watched with interest. Idaho is a State with a grand future, and the men who are molding her institutions should fully realize their responsibility to posterity.

The most interesting single movement now on foot in the West is the revival of irrigation hopes in the semi-arid region.

This wide belt of fertile country extends from the northern limit of the Dakotas to the southern border of Texas, and lies between the ninety-seventh meridian and the foot-hills of the Rockies. It differs historically and physically from the arid region proper. It was settled by men who did not believe in irrigation and did not dream that it was necessary to practice it in order to prosper on these "agricultural lands," as the Government called them. They have fought through years of hardship; indulged the delusive hope that the climate was about to change; bombarded the sky with explosives and wooed the clouds through the agency of mysterious chemicals and awe-inspiring machines with funnels. And now they come to the consideration of scientific irrigation, based on the utilization of such water supplies as nature has provided. This is the real hope of prosperity for the men of the semi-arid region, but it yet remains to be seen whether this is to be a serious, enduring movement, which will persist until actual results are achieved, or whether it will be merely a passing spasm like the irrigation enthusiasm which marked the history of Kansas and Nebraska in 1890. Although the water problem presents peculiar and perplexing phases, there is no question whatever about the future of the semi-arid region if it can have even a moderate degree of irrigation. There is ample ground for this hopeful note, so eloquently sounded by Secretary Martin Mohler, of the Kansas State Board of Agriculture, in his address before the Agricultural Congress at the World's Fair:

I think of it! Here in the middle of the United States is a district of country 300 miles wide and 1,200 miles long, embracing an area from which may be carved six States, such as the great State of Illinois, and a district of country which, in fertility of soil in smoothness, and ease of cultivation, and in the invigorating and health-restoring character of its climate, has no superior in America or in the world. This great empire ought to be, and, in my judgment, will be, reclaimed and in time made into homes embellished with all the arts of civilized life. All that



FRED L. ALLES.
Secretary National Executive Committee.

is necessary for this great achievement is to assist nature by the artificial application of water to the soil. It requires the proper manipulation of the water below the surface and the water on the surface, together with the water floating in the air, to perform this work, and in this way the water from all available sources being brought into requisition, the thing will be done. Who dare say that the skill, genius and enterprise of the American people is not equal to the task?

Under the inspiration of such teachings as this, the men of Kansas have gone to the *Two Notable Conventions*. work to find the solution of their problem, and they have had recourse to that nursery of ideas—the popular convention. The meeting of the State Irrigation Association, held at Wichita, November 23d and 24th, was a gathering notable for its serious and earnest character. Elsewhere in THE AGE there is an account of the ideas presented, but in this place it is proper to note the relation of the event to the general movement that is rapidly taking shape in the West. Irrigation in Kansas and in Wyoming for instance, present entirely different aspects. In the latter it is the hope of obtaining a population; in the former it is the hope of supporting a population already obtained. That is the economic difference. On the physical side, the one locality has quite abundant water supplies flowing upon the surface, while on the other hand Kansas, Nebraska and Texas require much patient investigation to determine the nature and extent of their supplies. These differences are quite vital, and yet the Kansas men keenly realize that they have much in common with the great arid empire to the west of them. They see that their hope

of relief from national legislation lies in the great organization set on foot at Los Angeles, and they are heartily co-operating with it. So also will the men of Nebraska, who assembled in a splendid convention at North Platte, December 19, and perfected plans for a systematic campaign.

Railroads and Irrigation. Most of the western railroads have been the generous and persistent friends of irrigation development. Of course their motive is selfish, for railroads exist for business rather than philanthropy. They realize that their future earnings will be measured by the number of new families who make homes along their lines, and that this in turn depends upon the number of acres reclaimed in their territory. The Union Pacific has been a very constant friend of those who are helping on the irrigation idea, and so also has the Sante Fe. The lines of both these railroads traverse arid wastes of tremendous proportions, the settlement of which would have a very pleasing effect upon their balance sheets. The Burlington & Missouri River Railroad in Nebraska has been another ally of the cause. Some of its officials, in their private capacity, have gone beyond simple moral support and invested largely in irrigation works in Kansas and Nebraska. The only exception observed among western roads is the Rock Island, one of whose representatives, at its headquarters, in Chicago, is still fighting "irrigation nonsense" and insisting that any part of Kansas is suitable for farming without the artificial application of water. Whether this man is sincere or not will make little difference to the unfortunate settlers who may be deluded into the hopelessly arid portion of Kansas lying west of the 97th meridian. Years of heroism and hardship have demonstrated that without water that is a starvation belt. And it is little short of criminality to impose upon innocent purchasers a sort of land that must be paid for in children's hunger and women's tears.

Interest in Small Plants. One of the most important developments of the new year will be the renewed interest in small individual irrigation plants throughout the arid region. This interest is now most prominently manifested in Kansas and Nebraska, where the chief dependence for water is upon underground supplies, but it is certain to extend throughout the West, as manufacturers of pumping machinery extend their knowledge of the requirements of the public. The trouble has been that these manufacturers have had only the most meagre appreciation of the field open to them in this direction and have expended neither money nor thought in preparing to meet the widespread demand. There was a good display of pumping machinery at the World's Fair, but a woful ignorance on the part of manufacturers of everything essential to the intelligent use of their appliances in

the work of irrigation. They could not calculate either the cost or capacity of their plants as applied to specified situations. They had no notion of the amount of water required for the irrigation of different crops, or of the nature of the water resources to which their machinery must be applied. Elsewhere in this number of *THE AGE* Mr. B. A. McAllester, land commissioner of the Union Pacific Railroad, groups more interesting facts about windmill irrigation than we have ever seen before in one article. It answers a multitude of questions.

A New Kansas Leader. Howard V. Hinckley, who was elected consulting engineer of the Kansas Irrigation Association at the Wichita convention November 23, is a native of Massachusetts. He graduated from the Worcester Polytechnic Institute in 1876 and was admitted to membership in the American Society of Civil Engineers in 1883. He entered the service of the Santa Fe Railroad in 1877 as draftsman, and after numerous promotions has for twelve years been in charge of the chief engineer's office of the entire system, at Topeka. In connection therewith he has been assigned such specialties as bridging, interlocking, terminals and water supply. His experience in irrigation dates back to the '60's, when he helped build the first irrigating canal in Massachusetts, and thirty barrels of irrigated cranberries per acre (some of which sold as high as \$44 a barrel) were raised, which resulted in the cranberry "boom," which has hardly yet died out in New England. In connection with his railroad service Mr. Hinckley has studied irrigation and water supply throughout the Western States and in Mexico and has been an extensive collector and reader of irrigation literature. He has argued in favor of more extended irrigation before the American Society of Civil Engineers and elsewhere. Many compliments have been passed upon his success in enthusing the Great Bend (Kan.) convention last August. In September he addressed the Salina (Kan.) Inter-State Convention. At the Los Angeles International Congress he prepared and delivered the reports on permanent organization and the "Wright Law" inspection trip, both of which were unanimously adopted. At the Wichita (Kan.) State Convention (for which he did a large share of the preliminary work) his topic was: "In Arid Kansas and the Way Out." At every one of these conventions Mr. Hinckley has called the attention of the States to the fact that the Government in its investigations has helped those States that had helped themselves, and that their first step should be to provide for their own irrigation departments. The following extract, from the Los Angeles address, is in Mr. Hinckley's own words:

We advise each State which embraces any part of the arid domain, and which has not already provided for irrigation supervision and engineering, to do so at its next legislative session and to vigorously prosecute the work of investigating the extent

to which further irrigation can be carried on with success and profit.

A year ago he had a bill ready to put through the Kansas Legislature, but the three-party political mud-dle got so thick that he gave it up. Now, with inter-national, national, inter-State and State interests all awake, there is hardly any doubt that the Kansas Legislature will act next winter, and the friends of ir-rigation in Kansas propose that Mr. Hinckley shall then accept the State engineership.

*Texas alive
to Irriga-
tion.*

There is a pronounced awakening in Texas on the subject of irrigation.

The interesting article in this number of THE AGE by Robert J. Brown throws much light on some unique phases of the subject. More letters of inquiry are just now received at the office of this publication from Texas than from any other State. This is an unerring indication of the widespread and growing public interest in the subject. It is asserted that land lying near creeks and rivers has been reclaimed at a cost of \$5 per acre, and is now worth an average of \$40 per acre. It is also claimed that several hundred thousand acres are capable of reclama-tion by means of pumps, and that plants costing from \$500 to \$2,000 easily pay for themselves in a short time. The difference between a Texas drouth and a Texas season with abundant water is so great that it is believed even \$20 an acre for reclamation is a very profitable investment.

*Statehood
this year.*

If the new year shall bring statehood to the Territories it will be a happy new year for them. And statehood should be given in precisely the same spirit that an enterpris-ing merchant displays his latest and choicest wares in his best show window. It is high time that Uncle Sam went to his storehouse, unloosed the territorial wrappings from Arizona, New Mexico and Utah, and put their marvelous attractions on exhibition where the millions of people and millions of dollars looking for homes and investments could see them. A mis-taken notion exists in the eastern brain on the subject of what constitutes fitness for statehood. The popu-lar idea is that a certain number of people is the single requirement. On that theory Delaware, Rhode Island, Vermont and some other insignificant eastern States should be reduced to Territories, while New York, Pennsylvania and Illinois should be par-titioned off into several new States. Did anybody ever inquire how many people there were in Massa-chusetts when statehood was conferred upon her? The matter of population is considered only with rela-tion to western Territories. In any true estimate of fit-ness for sovereignty actual population would be the last consideration, and capacity for development the first. The Territories each present a wonderful field for enterprise. They are capable of supporting vast



WILLIAM H. ROWE.

President Bear River (Utah) System.

numbers of people and adding enormously to the na-tional wealth. The territorial form of government is the effective bar to the attainment of the very condi-tion which the eastern man prescribes as the one es-sential to statehood. Is it fair to tie a man's legs and then tell him he must beat the record as a sprinter? Is it fair to impose upon Arizona, New Mexico and Utah the political conditions which prohibit the rapid expansion of population and then tell them they must have a certain number of inhabitants before asking for statehood? It is alike a matter of business and of justice to admit the Territories to the circle of sov-eign States without delay.

*South
California
Hopes.*

Within five years there will be an urgent demand for the making of another new State in the West. This call will be for the State of South California. The differences be-tween Northern and Central California, on one hand, and Southern California on the other, are fundamental. They never can be reconciled. One part of the State was born of the mining camp and the other of the irrigation canal. San Francisco and Los Angeles have each their individual charms and advantages, but they are the capitals of two civilizations. The great baro-nial estate is the type of one civilization, and the small irrigated farm of the other. One end of the State is full of the monuments and traditions of a race of greatly rich, and its counterpart, the miserably poor. The other end of the State has built an industrial sys-tem based on something like human equality, and

its life-current flows through the irrigating canal. Southern California is already fit for statehood. Its seven counties are larger than Illinois or Iowa, and as large as Michigan. They are as large as the combined areas of Connecticut, Massachusetts, Delaware, Rhode Island, New Jersey and Vermont, and of The Netherlands and Belgium in addition. These States and countries support 18,000,000 people. Southern California has to-day but 300,000. But its population, like its commercial importance, is rapidly growing. The best presentation of the claims of Southern California that we have seen was written by W. C. Fitzsimmons, the accomplished editor of the *California Fruit Grower*.

*Outlook
in the
Oil Field.*

One branch of western resources which has never been exploited, much less developed, as it deserves, is natural oil. Everybody admits the existence of large oil fields in Wyoming. Companies have been organized and have obtained control of large areas, yet development proceeds but slowly. Why? One of the leaders in the enterprise explains it by saying that there is one railroad alone which taps the fields, and that railroad is controlled by the Standard Oil Company. As a consequence, freight on Wyoming oil is placed at a prohibitory figure. We do not know if this is true, but it is a most reasonable explanation of the fact that these great resources lie unworked, while the State that nature endowed so richly is suffering for the capital and population that this development would bring. It is rather hard that a State should be held down in a growth that would add to the wealth of the whole people, in order that a little group of men, already multi-millionaires, should grow richer and continue to fix the price of a natural product of the earth. There appear to be hopeful oil prospects in Archuleta County, N. M., but they will encounter the same fatal obstacle if found valuable.

*The Arizona
Oranges.*

Ripe oranges from the Salt River Valley of Arizona were received in Chicago previous to Thanksgiving. They were large, perfectly matured and of a rich, red color. They created a good deal of surprise, as the public has not yet learned to expect oranges from this source. The Phoenix papers state that the Arizona Improvement Company has 125 acres of trees now in good bearing and that the season has been entirely successful. The writer saw several new groves on both sides of the Salt River a year ago and is informed that in most instances the trees have done well. Phoenix people count heavily upon the successful culture of oranges as a factor in the rapid development of the surrounding country. They argue that if the fruit can be grown there land now selling for \$50 an acre ought to rise at once to something like the Riverside and Redlands valuation which is frequently \$250 to

\$500 per acre for raw land and \$1,000 to \$1,500 an acre—sometimes even higher—for groves in full bearing. In view of what has been accomplished by the Improvement Company these hopes do not seem extravagant. They should be qualified to the extent of saying that the limitations of the orange belt are not yet defined. It is hardly expected that citrus fruits can be grown successfully in every part of the valley, but it has apparently been proven that a citrus belt does exist and that land will be very valuable within its limits. The Arizona oranges will compete with the Florida rather than the California crop, being several weeks earlier in the market. Phoenix enjoyed a marked growth last winter and seems likely to gain another impulse this winter, in spite of the prevailing hard times.

*The Boom
in Gold
Properties.*

There is an element in the West that is bound to be engaged in mining, no matter what conditions prevail. Now that silver is no longer profitable these men turn to the pursuit of gold, and if gold should become unprofitable they would turn to rubies and sapphires. The result of the depression in the silver industry is a new impulse to the chase for gold. As a consequence squads of prospectors are searching the mountains of Arid America for indications of the only metal that now measures the world's commodities in the view of bankers and statesmen. All the old camps show signs of revival, while in Idaho, Colorado, Utah, Nevada, Montana, Arizona and New Mexico numerous new mines and districts are coming into prominence. Even the old, wornout placer grounds of the California Forty Niners are again patiently inspected. The result is certain to be a considerable addition to the total gold output. In Colorado, according to the Denver press, this new phase of the industry has already begun to excite high hopes of better times. New Mexico is also getting surprising results, if current accounts are reliable.

*Western
Railroad
Develop-
ments.*

Without doubt the hard times will lay a heavy hand on railroad construction in the West. Economy to the utmost farthing is the order of the day with railroads, whether in the hands of receivers or out of them. There are three new lines practically determined upon, the building of which would be a very great blessing to the arid region. They are (1) the road from Salt Lake City to Los Angeles, (2) the road from Prescott to Phoenix, and (3) the road from San Diego to Phoenix. Some construction is now underway on the latter line. If all three could be built this year the result would be a most marvelous development of agricultural, mineral and commercial possibilities. The people of California are congratulating themselves on the successful efforts of the Traffic Association to secure cheaper transportation to the Atlantic seaboard for

their dried fruits. The reduction reported is sufficient to prove a material factor in the prosperity of the producers.

Oh, for this Railroad. Of all the railroads that might be built to employ the idle labor of the country to-day the most beneficent would be the

line suggested between Salt Lake City and Los Angeles. Better than almost any existing line this would illustrate the high function of the railroad as an avenue for the exchange of products between localities of radically different capabilities. This road would open to the citrus fruits of Southern California the splendid markets of Utah, Idaho and Montana. It would furnish an outlet for agricultural and horticultural products, which the high altitudes raise with more success and profit than the expensive lands of the South, and it would encourage the budding manufacturing industries of the inter-mountain States. Not only this, but it would open up to the miner the wonderful Deep Creek country of western Utah and eastern Nevada, and awaken the slumbering agricultural possibilities in the central and southern portions of the latter State. And if San Diego rather than Los Angeles be made the western terminus, it would give the localities connected with it by this road the benefit of the grandest seaport on the Pacific coast. Further than this, the existence of such a direct line between the growing cities of the mountain regions and the growing cities of the far southwest would develop a surprising passenger traffic. Utah would then winter in California and California would summer in Utah—the fairest land beneath the western sky! It is exasperating to realize that this inevitable railroad of the future, with all its potentialities for good, must remain unbuilt for an indefinite period to the tremendous disadvantage of the men of to-day.

Nevada is alive again. Nevada would be benefited more than any other State by such a railroad, but

Nevada is not basing its hopes of a revival of activities upon contingencies so remote as that. From the time when Hon. Francis G. Newlands began to assume the place of leadership in that State the possibilities of reclamation and settlement have been steadily kept before the public. When he published his "Address to the People of Nevada," relating to storage and reservoir sites and irrigation systems, he started public thought in earnest in a new direction. The result is seen by the present activity of the Nevada State Commission, appointed by Gen. John E. Jones under the Los Angeles platform, and in the general discussion of the subject in the press. The renewed interest amounts to a genuine revival. What is needed now is a systematic scheme of colonization

to attract people to Nevada. This will come. Gen. Jones and his colleagues have the daring ambition to locate the next irrigation congress at Carson or Reno and the claims of Nevada on this point will be fully presented in *THE AGE* at the proper time.

The Midwinter Fair. The Midwinter fair at San Francisco will prove to be an event of very much more interest than the public at first expected.

While it will not duplicate the Chicago fair in any respect, it will still be worth a trip across the continent to see. And the fact that it is unlike the great show of last summer will make it all the more worth seeing. The first reward of the trip will be that charming spectacle which too few Americans have seen—California in winter. Any undertaking which induces our insular easterner to explore his country is praiseworthy. The site of the Midwinter fair is typical of the glories of the Pacific coast. Golden Gate Park is superior to Central and Fairmount parks, in New York and Philadelphia, respectively, as mere landscape. The fair buildings are quite as beautiful in their way as those at Chicago, and within its limitations the exhibition will be complete. The Midway Plaisance will be there, but Chinatown is a more vivid and equally picturesque affair. Credit for the success of the San Francisco enterprise is due first to Director-General M. H. De Young and his newspaper, *The Chronicle*, and next to the *Examiner*, which has devoted money and energy to exploiting it with lavish generosity.

"The Age's" New Features. The new character of the IRRIGATION AGE as a comprehensive "journal of Western America" is not fully represented in this number, but the ideal will be approached by gradual steps.

New departments soon to be added will be "Irrigation Engineering," by a practical man of reputation, "Irrigation Law" and "The Mining Industry." The latter will aim to present a better general review of the month's developments among the mines of the West than can be found elsewhere, although it will be in the form of a compact, well-digested statement of a few pages. The department on colonization will sketch the best efforts yet made in this field, with suggestions for new ones and information of progress. "Water Power and Electricity" will point out the opportunities existing for this development and deal with the methods of utilization. And, let it be understood, the broadening process will in no way impair the value of *THE AGE* as the great exponent of irrigation, but will serve rather to draw together all the elements that are working to develop a symmetrical industrial and social life in Arid America.

A CREATION OF THE CALIFORNIA DISTRICT LAW.

EDITORIAL STUDY OF THE TURLOCK-MODESTO WORKS.

ON a certain morning late in October the author of the District law of California and the editor of the IRRIGATION AGE drove through the quiet streets of Modesto, the capital of Stanislaus county, Cal., just in time to see the sun rise over the Sierra Nevada mountains. It was a typical autumn morning for that portion of the San Joaquin valley. The air was clear and crisp and the undulating plains, that stretched for indefinite distances to the north and south, suggested a sea of brown, dotted only at far intervals by green islands. These latter marked the homes of farmers who eke out a poor existence on a section each of as rich soil as the sun ever looked upon.

The lawyer and the journalist had just come from the five days session of the International Irrigation Congress, where they had been studying the famous California statute, from an intellectual standpoint. They had now set out to study it as a practical thing in the precise locality whose necessities gave it birth. It was from this district that C. C. Wright went to the Legislature to fashion an idea into a law. It was here that those twin revolutions—the small farm vs. the great farm, and public ownership of water vs. private control—first raised the voice of protest against conditions which appeared to stand in the way of the progress of civilization in the heart of this wonderful valley.

Coming, with senses sharpened from the recent debates at Los Angeles to the birthplace of the District system, these men entered with an enthusiasm that seems not unnatural upon their journey up the banks of the Tuolumne river to the works of the Turlock and Modesto districts. They felt that here, if anywhere, the operation of the law could be studied with fairness both to those who have hoped so much of it, and to the smaller but not less aggressive class who have predicted its failure and final destruction.

II.—TWO TYPICAL DISTRICTS.

These two districts furnish a perfect illustration of the application of the law as originally conceived. It will be remembered that the Los Angeles platform distinctly disclaimed the theory of some enthusiasts that the District law furnished the solution of all the problems involved in irrigation development. Mr. Wright made it equally plain in his speech, at the recent congress, that the system can deal successfully only with such lands as are held in private ownership. It must be perfectly understood that this law is adapted to localities where irrigation is an after-

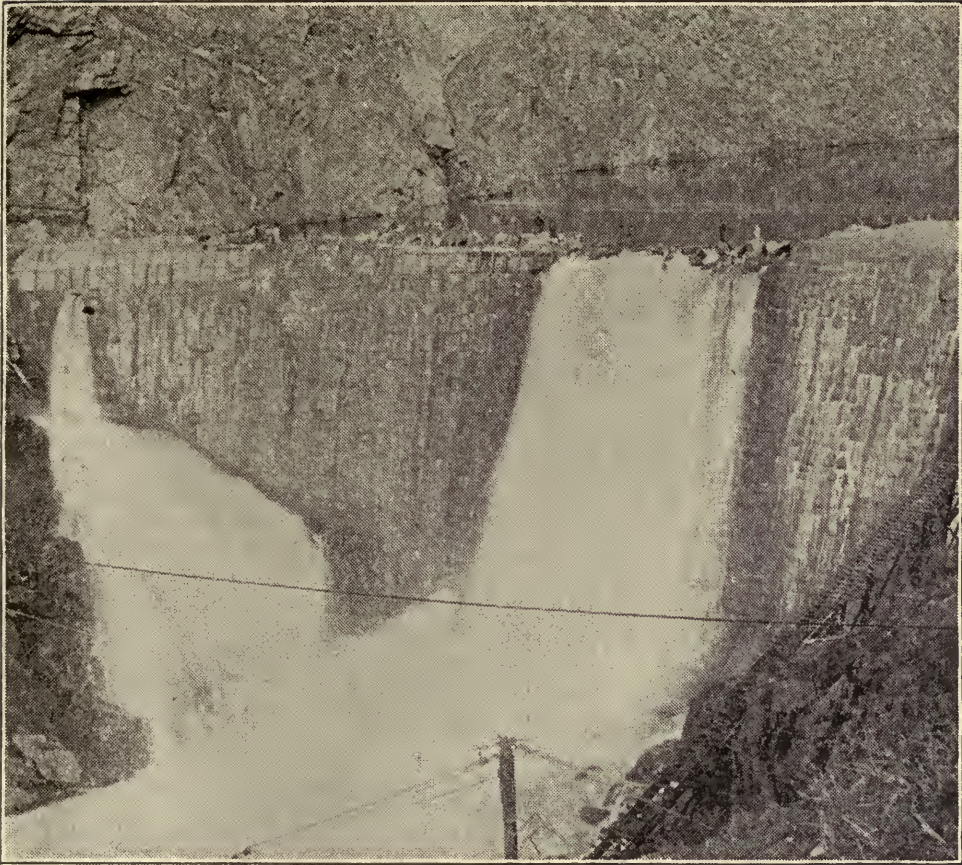
thought rather than a condition of original settlement. In the great virgin deserts of the arid region recourse must be had to other systems, but in the numerous localities which lie along the borders of humid regions, near the Pacific Ocean, on the one side, and the Mississippi valley, on the other, the District system is the most expedient. Those who believe the day is coming when irrigation will be rapidly extended through the central and, possibly, the eastern States will see in this California experiment something with far-reaching possibilities, for those older States will encounter, when their time comes, the same set of difficulties which faced the settlers of the San Joaquin valley a few years ago.

AN UNFORTUNATE RAINFALL.

The locality of the Turlock and Modesto districts has the misfortune to possess a fair rainfall. This circumstance is responsible for the fact that men have deluded themselves for years with the notion that agriculture could be prosperous without irrigation. Year after year they have learned the lesson that the richest soil and the warmest sunshine can produce nothing, except mortgages and poverty, without a sufficient amount of moisture. In their struggle for a livelihood they have reached out for more and more land, hoping to make up in quantity what they lacked in quality. As a result we see here a country where the average farm consists of 640 acres, and where practically nothing is raised except wheat. When men cannot get a comfortable living from a section of land planted to one of the great staples, it is high time for reform. The evils of the one-crop country have reached the acute stage here. The farmer who receives, from the sale of a single crop, money enough to purchase the other necessities of life, can get along, although it is a wretched and unphilosophic plan at best. But the farmer who works under such conditions that he has no wheat when the price is high, and can get no price when he has plenty of wheat, is on the high road to ruin. That is the situation in the wheat-belt of the San Joaquin Valley, and it is much the same in the grain belt of the middle West and the cotton-belt of the South.

AN INSTRUCTIVE COMPARISON.

After years of disappointment the farmers living on both banks of the Tuolumne river learned this hard lesson. They compared their unhappy situation with the prosperous condition of farmers living in localities blessed with so little rain that nobody pretended to



THE LA GRANGE DAM NEARLY COMPLETED, TUOLUMNE RIVER, CAL.

deny the necessity of irrigation. They were annoyed to learn that ten acres of land scientifically cultivated by means of irrigation were actually worth more, for all the purposes of agriculture and horticulture, than a section of their land under dry farming. And when they remembered that nature had provided a noble river in their immediate neighborhood they instantly decided upon the nature of the reform they needed.

OBSTACLES IN THE WAY.

It was only when this point had been reached that the people realized that a new law must be devised to meet the necessities of their situation. They were confronted by the fact that a small minority of large land-holders would not patronize an irrigation canal because they preferred that the country should remain in its present state. Without the patronage of these large tracts of land no private enterprise would pay. They were also confronted by the fact that under the recognized principle of riparian rights they would be forbidden to divert the waters of the Tuolumne river to the outlying lands which it might be made to water.

From this situation was born the Wright law, which enabled a community, through the votes of a majority of its citizens, to condemn private rights and bond all the real estate within the limits of an organized district to raise means for the construction of irrigation works. Such was the problem and such its solution.

PUBLIC GOOD ABOVE PRIVATE INTEREST.

Those who have assailed the Wright law have generally done so without knowledge of the circumstances from which it took its being, but some who were familiar with the facts have opposed it as an unwarranted invasion of private rights. On this latter point it is hopeless to expect general agreement. There are those who hold private interest above the public good. Men who hold that view will still contend, after the District system has wrought out its very highest results, that it was a crime to tax the property of any man for benefits which he did not desire and that it was nothing short of communism to take private property for public uses, even if justly paid for. It is the opinion of such men that the

minority of large land owners should have been permitted to keep the majority of their fellow citizens in poverty, for all time, if they chose to block the pathway of progress. With this view the friends of the Wright law have no argument. They merely vote it down by force of superior numbers, and in so doing they represent the spirit of our popular institutions, as they were understood by the fathers, when they framed the constitution. The underlying theory of the Wright law is that men, not acres, shall count in the making of laws and institutions.

III.—THE IRRIGATION WORKS.

The picturesque little town of La Grange, in the foothills of the mountains, is reached after a thirty-five mile drive over the rolling valley lands. La Grange has two distinctions. It is the scene of Bret Harte's tale, "The Luck of Roaring Camp," and it is the place where Hon. C. C. Wright first pitched his tent when he came out West to "grow up with the country." The school-house where he presided still stands upon the hill, and some of the leading citizens testify, that the author of the District law believed in corporal punishment in their school days. The murmur of the river pleasantly disturbs the silence of the sleeping hamlet, which is the western counterpart of that forgotten village on the Merrimac which Whittier painted as "a cobwebbed nook of dreams." The canals skirt either bank of the river, at a higher level than La Grange, but the little town is the nearest settlement to the head works of the system.

WITH THE MEN AT THE CAMP.

The La Grange dam is reached by a climb of a mile and a half up the foothills. It occupies an advantageous point at the place where the large river emerges through a long and narrow canon and begins its descent into the valley. The camp at the dam was reached just as the large force of workmen were sitting down to dinner, and the writer desires to testify to the fact that these men live at as good a table as even a lawyer and newspaper man expect to find when they attend an Irrigation Congress. It was a pleasant sight to watch these scores of hearty men, sweeping like a cyclone through the substantial bill of fare. The only disheartening thought was that the thousands of unemployed in this country to-day are not being similarly fed while engaged in the construction of other irrigation works of this beneficent character.

THE GREAT DAM.

The La Grange dam, which serves as a work of diversion for the Turlock and Modesto districts in common, is one of the most solid and substantial pieces of construction in the West. The visitors are given every facility to examine the work and the methods employed upon it in company with the constructing engineer, William McKay. First, a word about the

dimensions of the structure. Its extreme height is 127½ feet, its width at the base 84 feet, and its width eleven feet from the top, where the curve begins, 25 feet. The dam is built on a curve with a radius of 300 feet and an extreme length of 320 feet. The lower face has a slope of 4.67 feet in every ten feet, while the upper face is perpendicular. The dam was nearly completed when the writer was there and the remaining work was being pushed with all the speed consistent with safe construction.

THE METHOD OF CONSTRUCTION.

The visitors were shown the method of construction from beginning to end while it was in the actual process of operation. The face walls are built of rubble masonry, the large irregular blocks being laid in cement mortar of two parts sand to one of cement. The center of the dam is built of irregular blocks laid in beds of concrete, consisting of two parts of sand, one of cement and six of broken rock. It was interesting to watch the process. The blue trap rock is taken from the walls of the cañon near at hand and crushed by machinery into pieces of about two inches in diameter, when it is thoroughly washed. It is then run through a revolving mixer and carried on the dam by elevated tramways. It is carefully tamped down, the large blocks laid in with crowbars, and the space then filled with concrete and broken rock. Taking a pick and striking portions of the concrete surface with their utmost strength, the visitors found that it was actually stronger than the rock itself.

THE CANAL SYSTEM.

The canals of the two districts receive their water by simple works at either side of the dam, the Modesto on the north and the Turlock on the south. The former has a capacity of 750 cubic feet per second and the latter of 1,500 feet. The Modesto system will serve 80,564 acres of agricultural land and the Turlock 176,000 acres. In both cases the water will be carried by wooden flumes around the sharp sides of the cañon to the point where the earthwork canals begin, but in the case of the Turlock system there is a pretty piece of tunnel work through the solid rock. The main canals are now completed over the larger portion of the two districts. There is yet considerable to do in putting the network of ditches in order for actual operation, however, but it could all be done in a very short time if money were promptly provided. The finished system will be one of the grandest works of irrigation on this continent.

AN INSPIRING SCENE.

It is impossible for a man of heart to stand upon the towering banks of the Tuolumne Cañon and behold the sight before him without emotion. Deep in the bottom of the cañon the river is roaring down the steep grade on its way to the valley and the sea. A little further up stands the massive stone dam,

rising 110 feet and mortised into the solid rock. Leading out on either side of the picturesque gorge are the noble canals through which will soon flow the silver streams that will awake the valley lands to new industrial and economic possibilities. This is inspiring, but it is only when the beholder has realized another fact that the whole force of the scene sweeps in upon his imagination. This other fact is that these massive works, these graceful canals, were built by the people and for the people. They mortgaged their homesteads that they might build and own forever the irrigation system which they had learned at last was essential to their prosperity. And so this creation of man's genius, industry and faith stands as a monument to the people.

The original plans were made by Col. Mendall, but they have been altered in some respects. William McKay has been the efficient constructing engineer from the beginning. Harry Crowe has represented the Modesto district. R. W. Gorrell, of San Francisco, is the contractor on the dam.

IV.—THE COMING TRANSFORMATION.

The first result of the introduction of irrigation on the lands of the Turlock and Modesto districts will be the division of large farms into small ones. It has already been stated that the present average is 640 acres. There are many farms, however, comprising as large an area as two or three sections. The average farmer cannot operate a large farm profitably under irrigation. What the new unit will be at first it is difficult to say. Perhaps it will be as large as 160 acres, as the average farmer feels equal to the cultivation of a quarter section. But with the gradual advance of scientific cultivation, and the growing pressure of population, the farm unit will gradually lessen until it gets down to an average of forty or twenty acres, an area on which a man can be perfectly independent of the outside world in the genial climate of the San Joaquin valley.

TRANSFORMING AN INDUSTRIAL SYSTEM.

After the division of farms the most interesting feature of the coming transformation will be the change in the industrial system on these lands. This is now almost exclusively a wheat country. With irrigation it will become a country of diversified crops. All the vegetables, all small fruits, all the deciduous fruits and perhaps the citrus fruits, in certain localities, will be produced by scientific cultivation and irrigation. There is no question whatever but what intelligent farming will produce upon twenty acres the variety of products which a family will consume, and a sufficient surplus for exchange at the grocery store for such things as the climate forbids, together with something for the savings bank. It is a very pleasant prospect to which farmers of the Turlock and the Modesto districts are looking forward in these tranquil winter days.

THE VERY LANDSCAPE WILL CHANGE.

Instead of the indefinite stretches of grain fields, on which the word "poverty" is written in too legible letters, we shall soon see on both sides of the picturesque Tuolumne closely settled neighborhoods of prosperous small farms. Each one will have its garden patch and its orchards, and, in front of every home, roses and pansies will nod to the passing stranger. All the way up the valley, from the railroad to the foothills, the landscape will speak eloquently of the advantages of irrigation. The day of the great landholder will be a thing of the past, and the day when men live on terms of equality will have come. If hard times should continue for half a century there would be no suffering among the proprietors of these small, diversified farms. The soil is good, the sunshine perennial. With water in the ditch no condition of prosperity is lacking, provided the farmer shall make it his first business to produce from his acres the necessities of existence. The picture that will be presented to the eye of the casual stranger will be very different from that which lay under the moonlight on the October night when Mr. Wright and his companion drove down from the foothills on the occasion here described. It will be a scene of even and unvarying prosperity, that condition which holds the promise of the only true happiness for men.

THE VALUE OF THE BONDS.

But one thing remains to be said. This is a reference to the value of the bonds issued by those two districts. The Turlock district has issued bonds to the amount of \$1,200,000, and the Modesto to the amount of \$800,000. In the case of the former these cover 176,000 acres, and of the latter 80,564 acres. These represent a mortgage upon the water supply, the great diversion dam, all the canals and other agencies of distribution; upon every acre of farming lands (\$10 per acre), every town lot, every business block, every dwelling in all the communities comprised within the boundaries of these districts. They take precedence of all other debts, mortgage or otherwise. Could any security be stronger? Not only the real values, but all the productive energies of these communities is sacredly pledged for the fulfillment of these obligations. The law upon which these bonds are founded has passed successfully through the lower courts, as well as the supreme tribunal of California. It remains only to be tested in the Supreme Court of the United States, and there its triumph seems certain. This verdict secured, and the massive works of the Turlock and Modesto districts will stand as enduring monuments to C. C. Wright and the men of California who sent him to the Legislature, and then carried out the provisions of the law which his genius and courage wrote upon the statute books.

THE ART OF IRRIGATION.

STUDIED WITH REFERENCE TO VARIOUS SOILS, CROPS AND CLIMATES.

BY T. S. VAN DYKE.

[The strongest single feature of THE IRRIGATION AGE for 1894 will be the exhaustive study of irrigation methods by Mr. Van Dyke, begun in the following pages. It is now nearly a year since the author entered into an agreement to produce these papers for serial presentation, to be followed by publication in book form and to appear as the initial volume of "The Irrigation Library," a group of volumes projected by the publishers of THE AGE. Mr. Van Dyke, in "The Art of Irrigation," will deal with the subject in its relation to various soils, crops and climates and will fully present the good and the bad points of all known irrigation methods. The demand for a standard work of this character has never been adequately met until now. The work is copyrighted and can only be obtained by regular readers of this journal. It will be attractively illustrated when opportunity offers.—EDITOR.]

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CHAPTER I.

IRRIGATION AN ART THAT MUST BE LEARNED—
DIFFICULTIES THAT BESET ONE TRYING TO WORK
OUT HIS OWN EXPERIENCE—TOO MUCH OR TOO
LITTLE WATER.

THAT perversity of human nature that leads us to take hold of so many new subjects by the wrong end seems to rejoice especially in misleading the beginner in irrigation. And there are many ways in which it works. It may so discourage him at the outset that he thinks his land is not adapted for irrigation, or that it injures the quality of produce, or that it does not pay the labor and annoyance, or that irrigation is at best but a wretched substitute for rain, and any country where it is necessary is a good country to vacate. On the other hand this perversity may mislead him into thinking he is accomplishing wonders when he is really losing money by the day. He may point to his trees with pride and honestly think Providence never permitted elsewhere such vines as his. And yet, though they look well and are apparently yielding well, they may be doing only half or even one-third of what they should be. They may also be suffering from wrong treatment in a way that shows no immediate results yet in a few years may make them worthless. One may also be injuring the land in various ways without suspecting it, and about the time he has lost considerable money may conclude that irrigation is a heartless hoax. As a rule any irrigation beats no irrigation. But there is no man who can afford to do bad work where he can as well do good; and nowhere does this apply with such force as in artificial watering of the soil on any extended scale. Nothing is more silly than trying to work out your own experience when some one else has done it for you. Especially is this true of a subject that is so certain to lay snares in the path of the beginner and keep him entangled in them so long as irrigation.

The first way to avoid the wrong track is to consider the reasons why vegetation needs water. This seems easy. It is easy when you think about it. But it is one of those things that few think about.

Vegetation requires water:

First. To enable it to feed. Unless the soil is sufficiently moist the fine roots cannot extract those chemicals which are essential to the growth of the plant.

Second. To furnish the sap and the water in the fruit, whatever it may be.

Third. To evaporate, or, rather, *perspire*.

The two first are included in the last, for if the ground is moist enough to give the plant all the water it needs to evaporate there is enough for the other two purposes.

The amount of water required for the two first is a mere trifle compared with what the plant evaporates. A plant, when working heavily, especially in hot weather and a dry air, like a man working hard, is throwing off a vast amount of water from its pores.

You may get an idea of the amount of this by bringing the branch of a growing tree or vine into a window. Run it into a perfectly dry glass jar and seal it up. Then chill the outside of the jar with cold wet cloths. If the tree is growing well the inside of the glass will cloud over with moisture in a very few minutes.

A man may accustom himself to working heavily with very little water, though in hot weather he would be the better for plenty of good water to perspire, but a plant cannot dispense with it, and unless fully supplied will fail in its work. This failure is generally partial, and may show itself in many ways. The only one I shall mention here, because it is enough, is the uniformity of the product.

Let us take as an example an eastern apple orchard when it has what is there called a "good crop."

The tree looks well, is well laden, the apples seem fair to the eye and are of good size. That is, every-

thing seems all right to one who has never seen anything better. But a man used to buying fruit on the trees, like most of the buyers in California, would not make an offer on it. You might think his notions were high, yet, when we come to pick the crop about one-third only, is fit for market, of which third not over one-half is of first grade. Of the remaining two-thirds the greater part is fit only for the cider press, while the rest goes to the pig pen. Of course a good many of the low grade apples are sent to market along with the rest, but as they go only toward helping pay the expenses, and often fail to do that, they can be counted only as fit for cider. Nearly all the profit is in the first grade, and the percentage of this is very light.

The failure of this tree to do full duty has probably several causes, but one of the main ones was a lack of sufficient water to evaporate at the right time. The orchard had not been plowed for an age, and the hard ground shed too much of the short dashing rains of summer, and did not absorb enough. Of the amount that did enter the ground the thick sod and weeds perspired away much that the tree should have had. Just at the time, too, when the weather was the hottest, the air the driest, and the days the longest, the rain held off several days or weeks too long, and this trick it may have played several times. Consequently, though the ground may have been moist enough to enable the roots to extract the chemicals from the soil, and enough to keep up the sap and the water in the fruit, it could not give the tree enough to perspire. *Transpire* is the scientific term, but *perspire* is more correct. The tree may have needed fertilizing, and undoubtedly the ground needed aerating, but no amount of these would have taken the place of plenty of water to keep all the pores of the leaves going at the right times. If you figure the leaf surface of a large tree you will find it very great, and though it might do pretty well and look all right the running out of the crop into a large percentage of low grade is inevitable unless the demands of these pores are complied with.

Nowhere is this so well shown as in the contrast between a young tree and an old one. A young tree perspires apparently as much in proportion to its size as an old one. Its roots should also cover as much proportionate space. Yet it is certain that a young tree may have nearly all of its fruit large and perfect, while an old tree of the same sort in full bearing, standing near it and having exactly the same treatment and conditions, may be loaded with fruit of which not a specimen is eatable. Many a self-made sage has by the work of a young tree been fooled into the belief that his land did not need irrigation. The county of San Diego, Cal., has been set back ten years by a lot of antiques who could not heed the warning that others

had been deceived in the same way. Though the proof lay within a hundred miles of their noses, they were too wise to go to see if any one else had ever been fooled by the same discovery.

The failure to keep up this supply of water for perspiration at exactly the right times may mean so many dollars an hour out of one's pocket without his suspecting it. It is the principal reason why the best orchards of the Atlantic coast yield so little high-grade fruit in comparison with the well-irrigated orchards of the far West and is the reason why the East must irrigate as well as the West and will do so in thousands of places before this book is forgotten. The rain is everywhere too treacherous to furnish at the proper time the water the trees must have. It may average up all right, but that is not enough. The control of the water is what is needed and in this lies the great advantage of irrigation over rain. Two weeks too long of dry weather may shrink your purse enough to pay for your entire irrigating plant if you have high-grade crops. And this same principle applies with more or less force to all crops. Some are of such low value that it may not pay to water them, but in the long run will do as well to let them take their chances on the rainfall. No rules can be given for determining that, for it will depend on the cost of water and its application in the particular case.

Having fully realized the amount of water vegetation needs and why it needs it, and that it is one of those things that, when needed at all, is needed very much, the next step is to understand fully the evils of too much water, or even a proper amount of water at the wrong times. Farther on we shall see these more in detail, but here we will glance at only two of them.

First, for good results the ground needs aerating. Any work on agricultural chemistry will tell you why but you need not go to books for the proof of it. You see it plainly in subsoil which is often just as rich as top soil but will yield little until it has been turned up for a year or two to the air and sun. The farmers used to call it "sour." It contains all the elements of fertility, but the air must penetrate it to get them into available form for the plant to assimilate.

The same is true of the top soil though the contrast be less striking. The formation or nitrates and the change of phosphates into forms that can be readily assimilated by the roots, with other processes of preparing plant food, are going on all the time, and the presence of air in the soil is essential to them. And this air must be constantly fresh or as nearly so as possible. This is proven by the difference between orchards in California irrigated in the old style without cultivation and those where the watering is followed by constant stirring of the soil. The difference is far too great to be explained by the retention of moisture by the mulch thus formed. The soil can be kept wet enough in other ways but the more you do

so without letting in the air, the farther you come from the best results. Mulches of various other kinds that retain moisture perfectly have been tried but they fall far short of the effects of stirring the soil.

The second evil, of too much water, that I shall notice here is reducing too much the temperature of the ground. Every product has its own special temperature, at which it will do best. Peas and turnips will do best in a soil too cool for good corn or melons. But most everything needs the soil somewhat warmer than the average temperature of rain and warmer than the water of many ditches generally is. Water from either source generally lowers the temperature at first, and it is not until the sun has raised it again that things begin to grow well.

If, therefore, too much water is used, it tends to prevent aeration of the ground and thus keeps it "sour," and it may hold down the temperature too much and check the work of the warm sun. There are other bad effects, to be noticed hereafter, but these two are enough to satisfy you that good irrigation means neither too much nor too little water, but just the right quantity, applied at just the right time. When one has done this you will never hear him talking about irrigated fruit being deficient in flavor. Such talk is now a badge of ignorance. Too much water is bad, and it matters not whether it comes from the clouds, direct, or through the medium of a ditch, but the right quantity at the right times will give the best results with anything that is grown in the soil.

Into one or the other of these errors you are quite sure to fall if you have a chance. If you have a small supply of water you are quite certain to flatter yourself that things are doing finely when in fact they are merely marking time instead of marching. Especially is this the case where you buy it by the thousand gallons, another grand discovery made by the sages of San Diego to hold back a country. It is like buying hay for your horse at so much a straw; as surely as you do it so surely shall you flatter yourself every day that that horse is keeping remarkably fat and can just as well get along with another straw or two less.

Reverse, now, the conditions and give you all the water you can run and, marvellous the change. You can now beat any Indian in wasting water. You will go far to the other extreme. The more loudly you boasted before of how little water things needed the more you will now pour on when it is not needed. You will be especially delighted to find how simple it is when the ground begins to bake from one overdose to pour on another instead of perspiring behind an odious cultivator. The fact that this discovery is as old as the hills and has held back for years every country where it has been done you will probably be as slow in learning as were the people of San Diego in learning that any one else had ever been fooled by the work of young trees into believing that their land needed no water.

(To be continued.)

IRRIGATION BY THE USE OF WINDMILLS.

By B. A. McALLESTER, LAND COMMISSIONER OF THE UNION PACIFIC RAILWAY.

AT the Interstate Irrigation convention held at Salina, Kan., on September 28, 1893, my attention was particularly drawn to the subject of pumping water for irrigation by means of windmill pumps. Several gentlemen were present from Garden City, Kan., who detailed, in a very interesting way, the results obtained in their locality by this means. Shortly afterward, in conversation with a gentleman from Julesburg, Colo., I learned that one or two farms were being irrigated in the same manner in the vicinity of Julesburg.

A RAILROAD GATHERS FACTS.

It then became a matter of curiosity to ascertain the extent to which this irrigation, by pumping, has been practiced throughout the country, and I prepared and sent to each of our station agents and land agents in Nebraska, west of North Platte; Kansas, west of W. Keeney; Wyoming, east and south of Cheyenne, and all of our agents in Colorado, New Mexico and Texas, a circular letter asking the names and addresses of any individuals whom they might know were

pumping water for irrigation purposes. In response to these letters I secured in the neighborhood of two hundred names of parties located in western Nebraska, southeastern Wyoming, northeastern and east-central Colorado, and western Kansas. To each one of those parties I sent a letter asking the locality of their lands, number of acres irrigated, power used, whether wind or steam, cost of plant and cost per year of operation; depth and diameter of well, depth of water, whether or not the well could be pumped dry; diameter of stream coming from the pump, capacity of pump in gallons per hour, average length of time per year of running the pump, and area and depth of reservoir. A large number of these letters have been returned with full and complete answers to the questions asked and in many instances accompanied by enthusiastic letters advocating this method of irrigation.

QUIZZING THE WIND-MILL MAKERS.

While awaiting replies to these letters to the individual farmers, I submitted to one of the prominent wind-engine pump companies a series of questions as

to the capacity, cost, etc., of wind-mills and pumps. From the pump company I learned that one horse power will raise a 5-inch column of water 100 feet; a 6-inch column seventy feet, and an 8-inch column forty feet; additional horse power will elevate the water in direct proportion. A 10-foot mill will develop one-half of one horse power; a 12-foot mill three-fourths horse power; a 14-foot mill two horse power, and each additional two feet in diameter of mill develops practically an additional horse power up to a 30-foot mill which develops eight horse power. The cost of the mills range from \$40 for the smallest size up to \$400 for the largest.

In response to an inquiry as to the estimated number of days a wind-mill will run during the year, the company replies as follows: "It depends on locality. Here in Illinois total output one-third or eight hours per day. Kansas and Nebraska will average double this amount." I think the estimated average for Kansas and Nebraska, as compared with Illinois, will be accepted without question.

I further ascertained from the pump company that a 5-inch pump geared to run forty-eight 8-inch strokes per second will discharge 1,860 gallons of water per hour; a 6-inch pump geared in the same way will discharge 2,760 gallons per hour, and an 8-inch pump will discharge 4,860 gallons per hour.

THE DUTY OF WATER.

From the printed report of the Colorado State Agricultural College at Fort Collins, Colo., I learned that the duty of water, as determined by actual measurement is one cubic foot per second running continuously for sixty to sixty-five acres of ground. This during the month of June when the greatest amount of water is needed for irrigation. During the entire irrigation season one cubic foot per second, if reservoired, is sufficient for 175 to 300 acres. The same report shows that by actual measurement the amount of water required for various crops ranges from 1.67 feet to 2.53 feet in depth. That is, if the entire amount of water necessary for the perfect irrigation of the land was applied to the land at one time, it would be necessary to cover the ground to the depth named, according to the crop to be irrigated. The report shows also that this measured depth includes the measured rainfall during the same season. For the purpose of estimates given in this paper, I will assume that the average depth required for crops is two feet.

WHAT A WINDMILL WILL DO.

From the statements made by the pump company as to the capacity of a pump, I learn that a 5-inch pump will discharge 1,860 gallons of water per hour. This is thirty-one gallons per minute or five-tenths gallons per second, and is equal to .06 $\frac{2}{3}$ cubic feet per second. On the Colorado basis as before given, a

stream running .06 $\frac{2}{3}$ cubic feet per second would irrigate about six acres of land; but the pump is only estimated to run about one-third of the time, consequently one-third of the water would be secured and about two acres could be irrigated direct from the pump.

I have a large number of reports from farmers who apparently put in their wind-mills originally for the sole purpose of securing water for stock, but have since been successfully irrigating orchards, garden patches, etc., from the surplus water without making any attempt to reservoir it. These reports show that such surplus water is sufficient to irrigate from one to three acres of land.

RESERVOIR POSSIBILITIES.

Now suppose a farmer expends a few dollars in constructing a reservoir 100 feet square by four feet deep, what would be the result? Such a reservoir will contain 40,000 cubic feet, or about 300,000 gallons of water, a 5-inch pump discharging 1,860 gallons of water per hour, will in one-third of a day, or eight hours, discharge 14,880 gallons. In twenty days of eight hours each (this is assuming that the wind-mill runs one-third of the time) 297,600 gallons of water will be secured, practically filling our 300,000 gallon reservoir. During the six months from April to September inclusive, there are nine periods of twenty days each, therefore the reservoir can be emptied and filled nine times during the six months, resulting in an aggregate of 2,700,000 gallons of water for irrigation purposes, equal to 360,000 cubic feet.

IRRIGATION AND RAINFALL.

The report of the Kansas State Board of Agriculture, for last year, shows that at Wallace, Kan., during the six months from April to September, the rainfall aggregated over fifteen inches. We have before found that an average of two feet in depth, including the rainfall, is required for practical irrigation; or in other words, two cubic feet of water per square foot of land. An acre of land contains 43,560 square feet, therefore, to irrigate one acre of land requires 87,120 cubic feet of water; of this $\frac{1}{2}$ or $\frac{5}{8}$ may be estimated as being the rainfall, leaving $\frac{3}{8}$ to be supplied from the reservoir. Therefore to irrigate one acre of land, during the season, requires 32,670 cubic feet of water; but our pump and reservoir will supply, during the season, 360,000 cubic feet or water enough to irrigate about eleven acres.

THINGS ACTUALLY DONE.

Now, we have seen what in theory ought to be accomplished with a pump and reservoir of the capacity named, let us see what our farmer's reports show as actually being accomplished. John Simon, of Garden City, Kan., reports a wind-mill pumping a 5-inch stream of water into a reservoir 100 feet square

by four feet deep, raising the water twelve to fifteen feet and irrigating ten to fifteen acres; the entire cost of his plant was \$140, with practically no outlay for operating expenses. J. F. Monson, of Julesburg, Colo., reports that he is irrigating eight to ten acres with two wind-mills raising a 3-inch stream of water twenty feet into a reservoir eighty feet in diameter and four and one-half feet deep. The cost of his plant was \$225. J. L. Diesem, of Garden City, Kan., is irrigating fifteen acres from a well thirteen feet deep, by means of a pump throwing 6,000 gallons per hour into a reservoir 140 feet by 153 feet and four and one-half feet deep. His plant cost \$350. Examples of these results might be multiplied indefinitely; but enough have been given to show that theory and practice bear one another out, and that, at a comparatively moderate cost, it is eminently practicable to irrigate ten to fifteen acres of land by means of a wind-mill pump.

DEPTH OF WELLS.

Another important question to be considered in this connection is the depth from which water can be successfully pumped by wind-mills for irrigation. Theoretically a five-inch column of water can be raised 100 feet for each horse power developed by the wind-mill. The Pump Company states that the practical limit of raising water is about 200 or 250 feet. Among the reports which I have received from the farmers I have a number of instances where the water is being pumped from considerable depths. Among them J. C. Houser, of Grainfield, Kan., is pumping from a well 56 feet deep. S. K. Wine, of Menlo, Kan., is pumping from a well 130 feet deep. S. T. Percell, of Grainfield, Kan., is pumping from a well 140 feet deep. Four wells at Weskan, Kan., are respectively 135 feet, 153 feet, 160 feet and 140 feet in depth. This shows that it is practicable to raise the water from

a considerable depth below the surface of the ground.

INDEPENDENCE ON FEW ACRES.

It is my opinion that the future irrigation of the plains country is to be largely carried on by means of wind-mill pumps. Each farmer can, independent of his neighbors, or of any irrigation company, and at a cost not exceeding \$250, irrigate from ten to fifteen acres of his quarter section, and ten to fifteen acres properly irrigated and carefully cultivated is as much as any man ought to undertake to cultivate under irrigation. On this irrigated ground he can raise those crops which will bring in the best financial returns, and can thereby insure himself and his family sufficient income to more than support them independent of the fluctuations of the natural rainfall. On the remaining portion of his 160 acres he can raise, by dry farming, the same crops in character and amount as he is now getting, and two years out of three he is bound to get magnificent crops from the non-irrigated land.

EFFECT UPON CLIMATE.

I am further convinced that if ten acres out of each quarter section of the plains country were irrigated the resultant evaporation from the necessary reservoirs, and from the irrigated land, would so disturb the existing climatic conditions that the long droughts which are now liable to be experienced would be permanently broken up, and that the average annual rainfall instead of coming at infrequent periods and in heavy driving storms, always causing more or less damage, would be obtained at frequent intervals and in the shape of gentle rains which would do the greatest amount of good. The result would be that from the non-irrigated land would be obtained each and every year fully as good crops as were obtained in western Kansas and Nebraska in 1891 and 1892.

OREGON'S PLEA FOR POPULATION.

What rapid immigration could do for Oregon was illustrated by Mr. F. J. Atwood, of Omaha, who was interviewed by a Portland *Telegram* reporter recently:

"If you could only start such an influx of people to Oregon as came to Nebraska between 1883 and 1888 you would soon have 1,400,000 people here instead of 400,000. I well remember when Nebraska did not have over 250,000 inhabitants, and we thought we were doing very well. Suddenly a wave of immigration seemed to roll in upon us, and our barren prairies became subdivided into farms, villages were started at every crossroad, small towns became cities, and railroads were built in all directions. This kept up until we reached and passed the million limit, and had not drouths and hard times come on in another wave we would now boast over 2,000,000 population.

"My point is this: Oregon is way ahead of Nebraska in resources, variety of products and diversity of climate. Where Nebraska supports one man in creditable shape, Oregon can support two. The valley of your big river, watered by abundant rains, and Eastern Oregon, made to blossom by irrigation, have a capacity of holding, without crowding, 5,000,000 people. All you require is to get myriads of farmers in the central West and East to appreciate the opportunity here, and they will come. But one thing more: There should be ready an abundance of reliable information, regulated by State statutes, telling them where they can get good homes and make an honest living. I speak frankly when I say that more injury has been done by men coming back to Nebraska, Kansas and Iowa, who were sadly disappointed, and inhospitably received, than by any other influence."

THE UNDERGROUND WATER SUPPLY OF TEXAS.

BY ROBERT J. BROWN.

TEXAS is a country peculiar to itself in the character of its climate, and particularly is it peculiar in regard to the natural irrigation of its soil.

It is doubtful if there is another country in the world with less humidity in the atmosphere, with less frequent rains and yet with a soil so fertile and so well watered by nature. Hundreds of rivers flow through the State, and many rise from the ground, sparkle down the valleys for a few, or for many miles, and disappear without finding an outlet either into any neighboring stream or into the sea. Rivers which spring full grown from the bosom of the earth are not uncommon here, and to have them sink from sight as suddenly and as completely "as if swallowed up by the earth" would seem a natural exit after so impetuous an entry upon the scene.

PECULIAR TEXAS STREAMS.

A glance at any good map of Texas will show a number of these strange rivers, which rise as other rivers do, but never find an outlet. It takes but a moment's thought to show that where these streams thus sink into the earth, they must continue their course under the surface, and in many instances seemingly detached streams are but continuations of others which have sunk from sight in higher ground, perhaps scores of miles away. Such in truth is the case, and scientific investigation has developed the fact that many portions of the State have at varying depths, vast systems of underground rivers, interlacing into a network which forms a natural water supply unequaled and practically inexhaustible.

There are immense tracts of country in Texas which are veritable deserts because of lack of water, but millions of acres of this same desert land will be reclaimed through the means of these underground rivers. The soil of Texas stands drouth better than that of any other State in the Union, a fact which some explain on the theory that a continuous system of almost insensible sub-irrigation exists on account of the large underlying streams of water.

WHAT THESE RIVERS WILL DO.

A magazine of the nature of *THE IRRIGATION AGE*, so thoroughly covering this interesting field, cannot fail to find much of importance to its readers in the peculiarities of the Texas water supply. They have already been informed of the possibilities of reclaiming the millions of acres now burning beneath the semi-tropic sun of Trans-Pecos, Tex., and the project now under discussion, looking to the construction of storage reservoirs in that locality by the State. In re-

gard to the utilization of the underground waters of the State, however, and the progress which has been already made in that direction there yet remains a rich field for their information.

It is a well known fact that the fountain-head must be higher than the mouth of the well, or no artesian well can be expected to flow. At first glance it would seem that Texas is indeed a most unfortunate State. Large tracts of land, bewildering in their extent, are found so utterly devoid of all apparent water supply, that even the known richness of the parched soil and the undoubted presence of valuable mineral deposits seem but a mockery, by the impossibility of utilizing them under existing conditions, but investigation has shown that nature has not by any means been so unkind as would seem. The State geologist, in his discussion of the water conditions of Texas, divides the State into three divisions called "The Gulf Slope," "The Central Basin" and the "Western Mountain System."

THE GULF SLOPE.

In many respects the first named division is similar in character to that of neighboring States on the east, but with that resemblance, it retains the Texas peculiarity of dry climate and underground water supply. It was at one time, for the most part, all embraced within the bed of that vast pre-historic ocean, which time has seen so diminished in dimensions, and which we now call the Gulf of Mexico. The deposits received from that ocean gave to the section not only a rich soil, but a series of geologic formations most favorable for the natural underground storage of water and the easy utilization of the supply. These facts are already demonstrated by the existence of successful wells in hundreds of places in the district.

The conditions for successful artesian wells are excellent. Large surfaces naturally disposed for catching the heavy periodical rainfalls, and the necessary formations for carrying them to lower lying land and delivering them at the surface in response to the demand of intelligence and science. The wells of Austin, San Antonio, Waco, Dallas and Ft. Worth are included in this district.

THE CENTRAL BASIN.

The "Central Basin" region shows a gradual slope toward the west and is bordered on the north by the Wichita mountains in the Indian Territory and on the west by the Guadalupe Mountains, in El Paso County, while in its western embrace is found a section of the "Staked Plain," a portion of that old time horror of the west, "The Great American Desert." There is

every reason to believe that the artesian supply of this locality will be all that could be asked, for though not yet demonstrated by practical experiment, as is the

already brought to the attention of our readers. This for the most part consists of numerous mountains and detached peaks surrounded by slightly undulating

plains. That underneath many portions of this section lie water supplies filtered down from the mountains further west is a fact beyond dispute. The natural conditions are favorable, and in fact, the Texas Pacific Railroad and the Southern Pacific have both sunk wells there which are in every way satisfactory. Even if this were not so, the facilities for the construction of storage reservoirs have already been shown to be very encouraging and such is also the case in other sections. Where it is true that artesian conditions are unfavorable, or that the supply will be weak or inadequate, the topography of the country is such, in almost every instance, that dams and reservoirs can be cheaply and easily constructed.

At this point the attention may properly be turned to the Colorado coal field district, where the most recent investigations have been made by the State geological survey, for there it seems to be an established fact that irrigation by means of artesian wells cannot to any extent be depended upon and at the same time there is every necessary advantage in favor of the successful construction of reservoirs and the storage of water.

THE PROPOSED DAMS.

In treating of this subject the geologist recommends dams according to the accompanying easily understood plans, the materials for which are easily access-

ible either in stone, clay or timber, the clays of this section being especially abundant. The first plan is for a stone dam and is easily understood as is also the second, which is of clay and is a popular design, and already largely used. The third is of wood and is evi-

Fig 1.

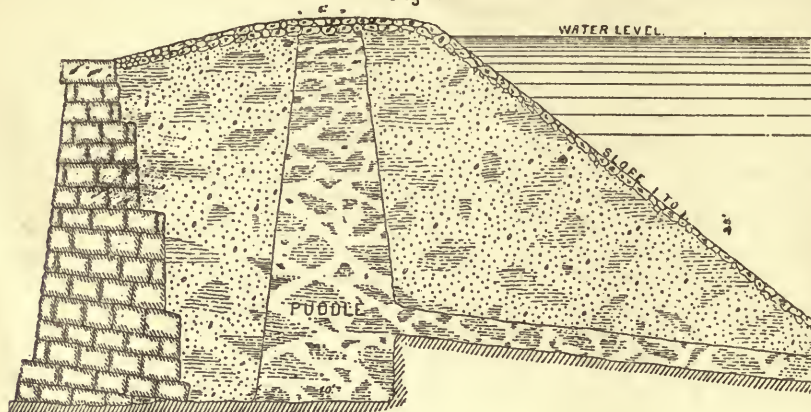


Fig 2.

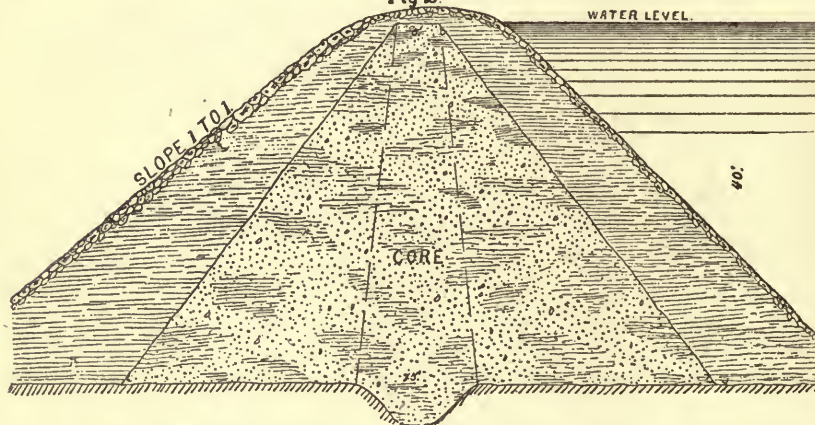
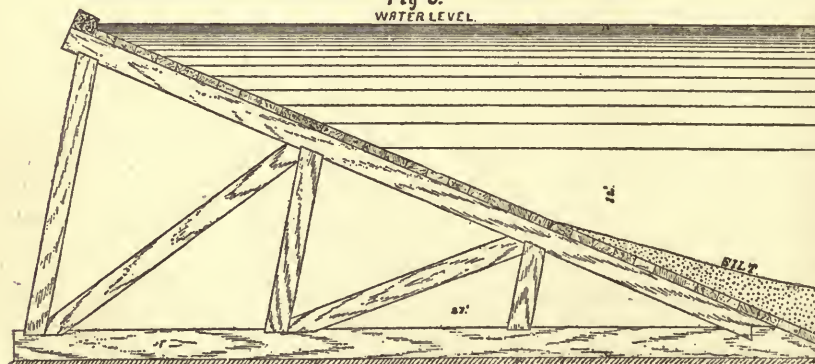


Fig 3.
WATER LEVEL.



DIAGRAMS SHOWING THREE PROPOSED DAMS.

case in older sections, the conditions are reported, by State Geologist Dumble, to be not unfavorable.

THE WESTERN MOUNTAIN SYSTEM.

The Western Mountain System embraces the dry plains of the west and the "Trans-Pecos" country

dently of a temporary character. The chief care in the construction of these and in fact all dams is to have not only the dams themselves made water tight, but the banks on all sides protected so that all leaks and seepage may be prevented. The city of Austin, which has just invested \$1,500,000, in a dam across the Colorado river, has had a most expensive lesson in this respect. The great dam had been completed, the gates were closed and the waters fell over the crest of the dam with a roar like Niagara, while back among the hills bounding the upper course of the river, a lake thirty-five miles in length was formed. The name and fame of the dam and lake were heralded to the four corners of the earth, but hardly had the news gone forth, when close on its heels came intelligence of the washing of the bank at the end of the dam, whereby the success of the entire structure was threatened. The damage has been repaired, but

after the expenditure of months of time and thousands of dollars.

With careful attention to details all such accidents can be easily prevented, especially in the case of small structures, such as for the most part will be those by which the water supply of the greater portion of the irrigation demanding sections will be.

HIGHLY FAVORABLE CONDITIONS.

From what has been shown it will be seen that Texas is most fortunately situated in regard to water when she shall be able to intelligently and systematically take advantage of the conditions under which that water is supplied. The soil is adapted to drouths and when they become too long the water can be easily supplied artificially, for in the absence of artesian conditions the conformation of the country is always favorable for the storage of surface water, and the proper material is always at hand.

THE OLIVE IN AMERICA.

THAT the olive tree is destined to be widely planted in various parts of the United States is reasonably certain. The tree is hardy, and will thrive under adverse conditions, though, of course, the best results follow the best care as in case of all other kinds of fruit trees. Whenever the American people shall have learned the great value of pure olive oil (which few of them have ever seen), its consumption will undoubtedly become very great. As a food and as a medicine there can be no question of the value of olive oil, and whenever such legislation can be secured from Congress as will lead to the honest branding of imported salad oil the industry will begin to take high rank in this country. It has been found by repeated analysis that not five per cent. of the so-called olive oil, imported into the United States, is pure, while a large percentage of it contains no olive oil whatever. The olive is at present produced on a large scale only in California, although trees were planted in Florida perhaps twenty years ago, and in some other of the Southern States even before that. While most of the olive orchards in California are still young, the acreage reported last year from that State was 7,997 acres. The tree will undoubtedly thrive throughout the southern parts of the arid West, and in the region of its possible growth the olive is found to be quite cosmopolitan, and will flourish in a great variety of places, cold being the main obstacle to its growth.

In California the berries ripen from November to January, according to location, and may be harvested when other work is not especially pressing.

Aside from the oil the olive is the most delicious pickle made, when it is properly treated. Most Americans are accustomed only to the use of the green imported olive pickles. To such, the rich, ripe, black or

dark purple pickled olives of California would be a pleasing surprise. Those accustomed to compare the two classes of pickles, assert that there is as great a difference in favor of the ripe fruit as between the green and ripe stages of any other fruit—even the peach.

The progress made during the past three years in preserving the ripe olive in the form of a pickle, has been remarkable in California, though the practice is not common in Europe. The ripe olive thus prepared has all the piquant character needed in a pickled food to a rich oleaginous food of the highest quality. Whenever, therefore, the American people become sufficiently educated to appreciate pure olive oil and ripe olive pickles at their true value as food substances, the demand for them will be practically unlimited. Readers of *THE AGE* in New Mexico, Arizona, parts of Utah, Nevada and Texas, should find the olive a profitable tree to plant in proper locations.

One great advantage of the olive, is, that the oil in the berry is manufactured in nature's great alembic from materials wholly drawn from the atmosphere, without making any draft at all upon the ingredients of the soil. If, therefore, the pomace from the oil mill be restored to the land, the olive orchard will need no further fertilization. Should the fruit be pickled, however, the trees would ultimately require fertilization in the same way as other fruit trees. Some planters have made the mistake of trying to establish profitable olive orchards upon land too dry, or upon rocky hillsides where the soil is thin and infertile. It may be here said that the olive tree resembles the cow. It will always do its best, but cannot be expected to give good results without food and shelter.

THE YAKIMA RIVER IN WASHINGTON.

By F. H. NEWELL.

THE Yakima river is one of the principal tributaries of the Columbia, in the State of Washington. Its drainage basin is a trifle south of the center of the State, and inclines southeasterly, the waters discharging into the Columbia about ten miles above the mouth of Snake river. The extreme length of the basin is approximately 135 miles, the greatest width 65 miles, the average width less than 40 miles, and the total area 5,200 square miles, or 7.78 per cent. of the total land area of the State. The upper edge of the basin lies along the eastern crest of the Cascade mountains, which rise to heights of from 10,000 to 14,000 feet, the most prominent peak, Mount Tacoma or Rainier, having an altitude of 14,450. The passes over the range are at an altitude of 4,000 feet and upward. This side of the basin is seventy-five miles long, thus including nearly one-third of the eastern slope of this mountain range, or at least of that portion of it in Washington.

THE WATER RESOURCES.

Among the mountains, which are densely covered with timber, the precipitation, in the form of rain and snow is heavy, and the streams, relative to the area drained, carry a large amount of water. Many of the higher valleys contain lakes, some of them of notable size, as, for example, Keechelus, Kachass, and Tloca-lum, near the northern end of the basin. These lakes serve as natural reservoirs, regulating, to a certain extent, the discharge of the streams, reducing the height of the floods, and increasing the summer flow. Their usefulness in this regard could be greatly increased at moderate expense by erecting suitable dams and gates at their outlets. From the lakes and tributary torrents, a number of creeks flow in a general easterly direction, finally uniting in Yakima river, which flows near the eastern side of the drainage basin. Few, if any, perennial streams come in from this side below the headwaters, the hills, which traverse the plain or plateau of the Columbia, not having sufficient altitude to receive much rain.

THE TOPOGRAPHY.

The topography of this region has been quite fully described by I. C. Russell in Bulletin No. 108 of the United States Geological Survey, entitled, "A Geological Reconnaissance in Central Washington," wherein is shown the peculiar structure of valleys and plains along the Yakima. This river passes with rapid fall in succession through a number of transverse ranges of hills, flowing with more gentle current through the intervening valleys. The total length of



A PORTION OF WASHINGTON, SHOWING YAKIMA RIVER AND TRIBUTARIES.

the river is about 170 miles, not taking into account the smaller bends. In the upper part of its course it falls at the rate of from eighteen to twenty feet per mile, or more. Lower down between Ellensburg and Yakima it averages about fourteen feet per mile, decreasing toward Prosser to about twelve feet per mile, and then to six feet per mile or even less. Throughout its course, however, it is a remarkably swift stream, and one which, flowing through a dry country, is unusually well adapted for employment in irrigation.

WATER MEASUREMENTS.

A few measurements of water have been made in this basin, and several gauges established for the purpose of obtaining the heights of water, and from this the probable daily discharge at these points. The uppermost of these gauge rods is near the outlet of Lake Kachass and about two miles northerly from the railroad station of Easton. The altitude of this latter place is, according to railroad levels, 2,180 feet, and it is probable that the waters of the lake are at an elevation of over 2,200 feet. The lake, or at least the

main body of water, is about nine miles long and from one and one-half to two miles wide. On August 16, 1893, the outflow of the lake, as measured at a point less than one-fourth of a mile below the outlet, was 211 second feet. About two miles below, and a half mile above Easton, this water joins that from Lake Keechelus, the two streams being approximately of the same size. The area drained by each of these headwater streams above their junction, and including the lake surfaces, is about 100 square miles.

COURSE OF THE YAKIMA.

The Yakima river, after receiving the waters of this lake region, flows in a general southeasterly and southerly course through the broad Kittitas valley, and then cutting across a series of ridges enters Selah valley, from which it escapes through a gap to Moxee valley. Throughout this upper course its flow is greatly increased by the creeks entering from the north and west. On leaving the gap in Selah ridge, and at a point seventy-five miles below Lake Kachass and a mile above North Yakima, the Naches river, one of the largest tributaries, comes in from the west. This stream was measured on August 14, 1893, at a point an eighth of a mile above its mouth. At that time the height of water on the gauge rod at the railroad ridge over the Naches was 100 feet, and the discharge was 1,193 second feet. The area drained, as measured from the Land Office map of Washington is 1,000 square miles, of which 300 square miles is within the catchment area of Tiaton river, the principal fork of the Naches river. The gauge rod at this point is fastened to the crib on the south side of the river sixty feet west of the railroad bridge, the 12-foot mark of the gauge being 9.97 feet below the top of the rails.

After passing along the west side of Moxee valley, Yakima river cuts through Yakima ridge, forming Union Gap, this point being seven miles below Naches river and six miles from North Yakima. Here the stream has been measured and gauge rods established to obtain the fluctuations of water. The principal rod is under the west end of the county bridge which crosses at this point. The zero of this gauge is 19.02 feet below the top of the rails on the railroad, which lie about 40 feet away. The high-water marks, presumably those of the spring flood of 1893, were on a level with the readings 9.90 of this gauge. On August 14, 1893, when the water stood at 0.90, the discharge was 2,963, and on September 26, 1893, as measured by Engineers J. B. Rogers and Samuel Storow, the water standing -0.25, the discharge was 1,186 second feet. By assuming intermediate values for discharges between the heights given, it has been computed that the average discharge for October, 1893, was 2,662 second feet, or for the whole month, a total of 163,713 acre-feet. The total drainage area above this point, as measured

from the Land Office map, is 3,300 square miles. Comparing this with the discharge for October, the average depth of run-off over the whole was 0.93 inches, or 0.81 second feet per square mile drained.

IRRIGATION ON THE YAKIMA.

There are a number of irrigating ditches taking water from Yakima river and its tributaries above this gauging station, most of these being in the Kittitas valley or in the vicinity of North Yakima. The principal irrigating works of the country are, however, below this point, taking water out upon the large valley in the vicinity and to the east of Topeish, or farther down the river near Prosser and Kiona. The largest canal in operation is that of the Northern Pacific, Yakima & Kittitas Company, heading a few miles below the gauging station at the county bridge. Other canals under construction heading near Prosser or at points below, cover strips of land along the river, and when completed will irrigate lands on the west side of the Columbia. The question of water supply for all these systems is, therefore, one of great importance. Comparing the estimated October discharge of the Yakima with that of other rivers, the remarkably large volume from a relatively small water-shed is apparent. This is best shown by the following table, which gives the discharge of various streams for October, 1893, and also in several cases for the same month in preceding years. Opposite this, for comparison, is placed the area drained, and in the third column the amount drained by square mile of catchment. These last figures bring out most strongly the large flow of the stream. All quantities of water are given in second feet (cubic feet per second of time), equaling about fifty miner's inches, as commonly measured.

COMPARISON OF RIVER DISCHARGES FOR OCTOBER.

RIVERS.	Discharge. Second Feet.	Drainage Area. Square Miles.	Run off per Square Mile. Second Feet.
Yakima, 1893.....	2,662	3,300	0.81
West Gallatin, 1893.....	576	850	0.68
Yellowstone, 1893.....	1,630	2,700	0.60
Missouri, 1891.....	3,511	17,615	0.20
Arkansas, 1890.....	505	3,060	0.17
Arkansas, 1891.....	624	3,060	0.20
Arkansas, 1892.....	511	3,060	0.17
Rio Grande, 1892.....	259	1,400	0.18
Rio Grande, 1893.....	263	1,400	0.19
Bear, 1891.....	980	4,500	0.22
Bear, 1892.....	780	4,500	0.17
Bear, 1893.....	737	4,500	0.16

From the inspection of this table, which might be extended to far greater length, it is apparent that the canal owners taking water from this stream have far less to fear as regards their water supply than have irrigators in other parts of the arid region.

THE NATIONAL ORGANIZATION.

NATIONAL EXECUTIVE COMMITTEE ELECTED BY THE IRRIGATION CONGRESS AT
LOS ANGELES, CALIFORNIA, OCTOBER 14, 1893.

CHAIRMAN, Wm. E. Smythe, Member-at-Large.
Postoffice Box 1019, Chicago.

SECRETARY, Fred L. Alles, Member-at-Large.
Los Angeles, California.

VICE-CHAIRMAN, Edward M. Boggs, Arizona.
Tucson, A. T.

TREASURER, John E. Jones, Nevada.
Carson City, Nev.

CALIFORNIA, Eli H. Murray, San Diego.

NO. DAKOTA, Dr. Merchant, Ellendale.

COLORADO, J. F. Rocho, Hardin.

OKLAHOMA, John H. Cottoral, Guthrie.

IDAHO, T. D. Babbitt, Nampa.

SO. DAKOTA, J. T. McWilliams, Aberdeen.

ILLINOIS, Willard E. Allen, Chicago.

TENNESSEE, P. H. Porter, Nashville.

KANSAS, J. W. Gregory, Garden City.

TEXAS, J. J. Walker, Barstow.

MONTANA, Z. T. Burton, Chouteau.

UTAH, Arthur L. Thomas, Salt Lake City.

NEBRASKA, Chas. P. Ross, North Platte.

WASHINGTON, G. N. Blalock, Walla Walla.

NEW MEXICO, M. A. Downing, Las Cruces.

WYOMING, Elwood Mead, Cheyenne.

COMMITTEE ON NATIONAL LEGISLATION.

W. A. Clark, Butte, Montana.

Richard J. Hinton, New York City.

Eli H. Murray, San Diego, California.

NATIONAL LECTURER.

J. S. Emery, Lawrence, Kansas.

THE IRRIGATION PROPAGANDA.

THE dawn of 1894 finds irrigation in the hands of an organized propaganda, the aims and methods of which are as sharply defined as are those of any contemporaneous movement in this or foreign countries. The plans made and making for this work will be rapidly developed to the public eye, as the year unfolds, but the great end to which they tend already stands clear and luminous before the men of the West, who see in it the fairest promise of human progress in the coming century. To utilize all the water and ultimately reclaim the utmost acre of desert soil, and then to develop, on irrigated lands, the highest degree of industrial freedom and the most satisfying conditions of social life—in short, to found a new civilization wherein human equality shall be a fact and not a theory—is the sublime task in hand.

LAYING THE FOUNDATION.

The people of the arid States and Territories will be expected, during the next few months, to formulate the irrigation policies under which these hopes of the future may be realized. There can be no enduring and stately structure unless there is first provided a broad, substantial foundation. This foundation must include, (1) an honest and workable national law for handling the arid public lands and interstate and international streams, and (2) a code of State laws recognizing certain common principles relating to water appropriation and to supervision of ditch construction

and management, as well as to systems of public administration. We are now approaching the vital stage of our formative period. We are just where the fathers were when they went into a five months' session to build the Constitution. They had declared independence and won the objects of the Revolution, but it still remained to formulate into enduring law the fundamental ideas upon which their new political and industrial systems should rest. Western men have declared their faith in the new industrial philosophy, they have established irrigation plants and developed communities after a more than seven years' war with prejudice, skepticism and numerous physical obstacles. And now the time has come to erect a system of permanent laws upon the broad principles of justice and equity officially uttered by the International Congress at Los Angeles.

HOW IT WILL BE DONE.

All this is no iridescent dream of impracticable enthusiasts. *It will be done.* The work is in the hands of the National Executive Committee, which is responsible to the Irrigation Congress, and of the State Commissions, which are responsible to the committee. The men at the head of the movement are bent on getting results. They will not fail in the performance of their full duty, nor will the people fail to support them. Events have so shaped themselves that the critical moment in this work has come at the time when the depression in mining leads the public to study, with earnest interest, the possibilities that lie in reclamation

and colonization. They will therefore lend willing ears to the appeal which bids them assist their State Commissions in finding the best features for final policies, national and State. The Commissions will consider these problems not only with reference to peculiar local conditions, but with due regard also to the general requirements of the subject. There have been three Irrigation Conventions since the meeting at Los Angeles. The first was held at Deming, N. M., under the auspices of the Southwestern Irrigation Association; the second at Wichita, under that of the Kansas Association; the third (December 19), at North Platte, under that of the society of that name. None of these were called by the national organization, though its officials were represented at each.

THE COMING CAMPAIGN.

The National Executive Committee is now planning a vigorous campaign that will extend through the early months of the year, beginning late in January, probably with the southwestern circuit and followed a month later with a tour of the northwest, from Denver to Tacoma. The plan will be made by the National Committee, but details in the various localities will be left to the State Commission. Chairman Smythe, National Lecturer Emery, and very likely, Major John W. Powell, and other well-known men, will be of the party. The object of these meetings is to arouse and unite the masses of the West; to expound the Los Angeles declaration; to discuss the various suggestions for national and State laws; to consider the local water and land problems, which must be taken account of in perfecting future plans. Opportunity will be given for general discussion from the floor, and it is believed that the State Commission will benefit greatly from the mass of suggestions thus offered.

WHERE MEETINGS WILL BE HELD.

The first branch of the campaign will probably be opened at Santa Fé, the ancient capital of New Mexico, and be followed by meetings at Las Vegas and Albuquerque, if desired. The next group, covered in the same trip, will be Tucson, Yuma and Phoenix. There should be a very notable meeting at the latter, the capital of the coming State of Arizona. One of the greatest events of the campaign, if properly organized and advertised, will be the mass meeting at Denver. No State has more to gain from the success of the present movement, and a rousing irrigation revival would be a splendid exhibition of Colorado's recuperative power. The Denver meeting will probably be the last of the first trip, or the first of the second. Other Colorado points will be covered, among them certainly Grand Junction, on the western slope. The northwestern tour will include Cheyenne, probably Salt Lake City, and at least one more point in Utah. In Idaho, Boise, Idaho Falls, Caldwell, and, perhaps, Payette or Weiser; in Oregon, Pendleton; in Washington, Walla Walla, North Yakima and perhaps

another point; in Montana, Helena, Great Falls, Bozeman and Missoula will be reached. These are the plans as they appear unperfected. They are yet subject to rearrangement and enlargement. Suggestions concerning the plan of campaign will be gladly received by the chairman, at Chicago.

LEADING UP TO THE NEXT CONGRESS.

All these plans are merely preliminary to the next session of the National Irrigation Congress to be held sometime between July 1 and October 15, at a point not yet determined upon. The results of these meetings and conventions will be to crystalize public opinion, but they will settle nothing. Beyond them lie the reports of the State Commissions, which it is proposed to publish by July 1, and beyond these reports lies the next congress, with its days of debate and hours of committee work. The congress, it is expected, will arrive, through study, discussion and compromise, at the definite declaration of the men of the West, and for that declaration they are expected to fight shoulder to shoulder until its triumph is complete. It seems likely that the decision will include a bill for presentation to the Congress of the United States, accompanied by a ringing address to the people, and also an address to the governors and legislatures of the several States and Territories, urging them to put local laws upon a common basis, the main features of which will be outlined.

These are the great results which the irrigation propaganda purposes to accomplish in the next ten months, but when these are achieved we shall but have entered at the vestibule of the great enterprise comprehended in the making of Arid America.

WHAT IS TO FOLLOW.

The next Irrigation Congress, like its two predecessors, will leave its cause in the hands of an Executive Committee. And, as the present organization turns its energies to the West to accomplish the objects set out above, so the next one must turn its attention to the East, to arouse public sentiment to the support of these measures, and to secure the co-operation of settlers and capital for the requirements of the new civilization. This year the accents of the orators of the sublime cause will sound under the southern palms of Arizona, and in the capitol at Boise; next year they must ring under the roof of Faneuil Hall in Boston, and Cooper Union in New York. The one movement will be the indispensable counterpart of the other. But this year the duty is to the West. It must be thoroughly and courageously performed.

THE STATE COMMISSIONS.

By another issue of *THE AGE*, it is hoped the make up of State Commissions will be complete. Committee-men have properly taken sufficient time to give very careful consideration to the selection of members of

these important bodies. Several are nearly, but not quite, ready to make their final announcements.

NEVADA.

As noted in the November number, Nevada was the first State to appoint its commission. It consists of Gen. John E. Jones, of Carson City, chairman; James Newlands, Jr., Carson City; L. H. Taylor, Reno; W. C. Pitt, Lovelock; R. M. Clark, Carson City. The first meeting of the commission was held at Carson City, November 13th. Mr. Taylor was chosen secretary and W. C. Pitt, treasurer. Chairman Jones was authorized to appoint agents in different parts of the State to solicit subscriptions to a fund to defray expenses of the commission, and to provide for Nevada's contribution to the Executive Committee of the National Irrigation Congress. The chairman and R. M. Clark were appointed a committee to draft a preamble to the address to the people to be issued, and also a petition to be circulated by the agents appointed to solicit funds. A committee of one was appointed for each county to collect data and compile statistics for the use of the committee: Churchill, Walter Ferguson; Douglas, H. F. Dangberg; Elco, E. C. McClellan; Esmeralda, James A. Yerington; Eureka, W. S. Long; Humboldt, C. A. La Grave; Lander, W. D. Jones; Lincoln, D. Bonelli; Lyon, J. E. Gigneaux; Nye, George Nicholl; Ormsby, J. D. Kersey; Storey, F. Hellman; White Pine, H. A. Comins; Washoe, C. C. Powning. A committee of three, including the chair, were appointed to formulate instructions to committees on data and statistics. A committee was also appointed to work for Nevada, as the place for holding the next National Irrigation Congress.

CALIFORNIA.

The California Commission has been named as follows: Eli H. Murray, San Diego; C. C. Wright, Modesto; W. S. Green, Colosa; L. M. Holt, Los Angeles; J. A. Pirtle, Los Angeles. Mr. Pirtle was chosen secretary. This is a very strong commission. Ex-Gov. Murray is a gentleman of wide and varied experience in public life, and is deeply interested in the progress of irrigation. Mr. Wright is thoroughly versed in irrigation law. Mr. Holt is the statistician of irrigation in California. Mr. Green is the most prominent champion of the idea in northern California, and Mr. Pirtle has a thorough mastery of the subject from the standpoint of investors.

SOUTH DAKOTA.

The South Dakota Commission is the following: J. T. McWilliams, Aberdeen, chairman; S. W. Narregang, Aberdeen; S. H. Riggs, Frankfort; A. B. Hassett, Redfield; Robert Evans, Spearfish. Of these gentlemen the well-known names outside of their State are Messrs. McWilliams and Narregang. They have been the consistent friends of irrigation in a locality where few have really understood its

full significance. This looks like a good working commission. Their opportunity to put the State to the front is a notable one, and it is to be expected that they will take the fullest advantage of it.

NEW MEXICO.

In New Mexico Mr. Heintzelman has retired from membership on the National Executive Committee in favor of Mortimer A. Downing of Santa Fe. The new member ought to be one of the most valuable factors in the organization. As private secretary of Col. R. J. Hinton, when at the head of the Bureau of Irrigation Inquiry, Mr. Downing had the best facilities to study irrigation problems as a whole. He traveled throughout the arid region and had the benefit of the knowledge of his chief. On retiring from that position he showed his faith in the future of Arid America by going immediately to New Mexico to make his home. He was designated by the convention at Deming as the choice of this Territory for this position, and his presence at the head of New Mexico's commission is a guarantee of vigorous and thorough work. The full commission will be named shortly.

WYOMING.

The Wyoming Commission has become involved in an embarrassing situation. William Penn Rogers, of Messina, Cal., temporarily represented the State on the executive committee at its first meeting in Los Angeles. He there made an announcement which the committee construed as notice of his resignation, based on the recognition of the fact that no State should be permanently represented by a non-resident. Three States were temporarily represented in the same way, and in all cases it was understood that the temporary members should retire after the organization had been effected, and allow their successors to be chosen by the committee, under the rule adopted by the congress. In pursuance of this understanding *bona fide* residents of Wyoming, Montana and North Dakota were chosen at the second meeting of the committee, held at San Diego. State Engineer Elwood Mead, who has been a member for two years past, was re-elected for Wyoming and promptly named a commission, consisting of prominent citizens of his State. Before this commission had been confirmed, Mr. Rogers notified the committee and the Governor of Wyoming that he had not resigned, and then proceeded to name a commission himself. Prof. Mead then tendered his resignation to the committee, but it has not yet been accepted, and will not be. He is the legal member and his commission the regular body. Both will act unless they positively decline. In that case the committee would elect Mr. Mead's successor.

OTHER STATES.

Committeeman Burton is hard at work in organizing his forces in Montana.

Great interest is felt in Judge Gregory's Kansas

Commission. There is no lack of good material in that State.

Prof. Boggs is expected to furnish a very brainy commission for the irrepressible and inextinguishable "State of Arizona."

The Idaho Commission is as follows: T. D. Babbitt, Nampa, chairman; Charles H. Irwin, Nampa; F. J. Mills, Pocatello; J. E. Ostrander, Moscow; A. D. Morrison, Idaho Falls.

The Nebraska Commission is as follows: Charles H. Ross, North Platte, chairman; J. M. Lee, Oxford; John R. King, Benkleman; B. E. Brewster, Harrison; George E. French, North Platte.

Committeeman Rocho announces that he has secured Ex-Mayor Platt Rogers, of Denver, and Prof. L. J. Carpenter, of Fort Collins, for two of the members of the Colorado Commission. That is a splendid start—the orator and the student. If Mr. Rocho holds to this standard his State will occupy a very conspicuous front seat at the next congress.

THE FIRST POLICY PROPOSED.

To the Editor of THE IRRIGATION AGE:

I desire to lay before the State Irrigation Commissions the outline of a plan for irrigating the arid lands of the United States, which I propose to submit for its consideration, and if considered of value, to be modified, amended and adopted. Of course I do not go into details—these can be arranged after the general plan has been adopted.

First, the Government is to establish a Department of Irrigation, and the head of that Department is to be a Cabinet officer. This Department is to examine all interstate streams and arrange for the distribution of the waters of such streams between the States through which they flow. It is also to supervise and approve all plans for irrigation systems by the States and Territories, under certain restrictions.

Congress is to pass a law giving the States and Territories jurisdiction over all Government arid lands within their respective borders for the purposes of reclamation.

Each State is to establish an Irrigation Commission, consisting of four Commissioners and a State Engineer, who are to be appointed by the Governor, and approved by the Senate. This State Commission shall have power to establish Irrigation Systems whenever it is ascertained that there is a tract of Government arid land which can be reclaimed at an expense sufficiently low to warrant the undertaking, with an assurance that settlers can afford and will take up the lands reclaimed. When the plans for the reclamation of a certain tract of land have been prepared, and estimates of cost have been obtained, the plans and estimates shall

be submitted to the National Irrigation Department for approval, and if approved, the State Irrigation Commission shall at once proceed to construct the works.

The State shall sell its bonds to raise money to carry forward the work in hand and the outstanding bonds of any state shall be limited as hereinafter provided.

When an irrigation System shall have been completed the lands under such systems shall be opened to homestead entry under the laws of the United States, in tracts not to exceed forty acres for each family or head of family, and no other way.

After one-half the lands under such system shall have been thus taken up, the State Commission shall proceed to form an Irrigation District, which shall include all the lands, that, in their judgment, can be irrigated under such System and no more. The district shall then issue to the State its bonds, which are to run for a period of forty years. Such bonds shall bear interest at a rate that shall be one per cent. higher than the interest paid by the State on its bonds to raise money for the irrigation fund. After a district has been thus organized and the bonds issued, the management of the affairs of the district shall be turned over to the people residing in such district, and all water rights, canals and other property, connected with the water supply of such district, shall become the property of the district, except, in the option of the State Irrigation Commission, approved by the National Irrigation Department, any reservoir which shall supply water to more than one district may be retained as the property of the State, and each district shall make an annual payment to the State of such sum as shall be necessary to keep up such reservoir, and supply such districts with water.

If at the end of five years from the date of opening up to settlement any irrigated tract, there is not one-half of the land within such tract taken up under the Homestead Laws of the United States, then, and in that event the remaining land shall be offered for sale in tracts of 160 acres or less, to each purchaser at such figures as may be fixed, not less than \$1.25 per acre, and all moneys received from the sale of such lands shall go into the district treasury to be used in reimbursing the State by paying off the bonds held by the State against such district.

Each State shall reclaim arid lands only as fast as there shall be a demand for the reclaimed lands for actual settlement, and the outstanding bonds of any State for irrigation fund purposes shall not at any time exceed the amount of bonds held by the State against districts by more than \$——.

This is but a brief outline of the proposed plan for your consideration.

Yours Truly,

L. M. HOLT.

PULSE OF THE IRRIGATION INDUSTRY.

THE COLORADO STATE CANAL.

THE building of the State canal by convict labor in Colorado is several kinds of an experiment. It is an experiment in the use of convicts, in the disposal of public lands, in the policy of public management of irrigation works. The work was authorized by an act of the Legislature of 1889, but only \$1,450 was realized from the appropriation of that year. The act, however, enabled the board to receive subscriptions in cash from persons interested, and to issue seven per cent. scrip, payable, both interest and principal, in water from the canal. In this manner enough money was raised to carry on the work with a moderate force until the Eighth General Assembly appropriated \$50,000 to continue the work.

ENGINEERS AND THEIR PLANS.

The location of the headgate was decided upon by Hon. James P. Maxwell, then State engineer, in June, 1889, and is on the south side of the Arkansas river, in the Grand Canyon, about 2,000 feet below the swinging bridge, or about three and one-half miles above the mouth of the canyon. This was immediately followed by the preliminary surveys under the personal supervision of Mr. John S. Titcomb, then deputy State engineer, and occupied a considerable portion of the season of 1889. Work was then commenced on a tunnel 750 feet in length through the "Prison-Hogback," that being the first portion definitely located because of convenience for working the convicts.

From the beginning of the work, the engineering on the canal was under the general direction of Mr. Titcomb, but as it progressed and assumed larger proportions, it became necessary to have an engineer constantly on the work, and in April, 1891, E. A. Smith was appointed resident engineer, and still holds that position, having been reappointed in May, 1893.

CANALS AND LAND RECLAIMED.

The canal, as located, will irrigate about 2,000 acres of the open park immediately northeast of Cañon City, will cross Eight Mile and Brush creeks, each at about four miles, Beaver creek at about four and one-half miles, and Turkey creek at about six miles from the Arkansas, and will strike the Fontanie Qui Bouille about two miles above Wigwam station on the Denver and Rio Grande river, or about 20 miles north of Pueblo. The final total length will be about 85 miles.

The dimensions of the canal will be: From the head to about the mouth of the Grand Cañon, the width 12 feet, depth 7 feet, with a grade of 5.28' per

mile. Outside the cañon the width is 15 feet, depth 9 feet and grade 1.76 feet per mile. This will again be changed to a width of 25 feet, depth 6 feet with same grade. The carrying capacity is estimated at 605 cubic feet per second and is calculated to irrigate over 70,000 acres of land. The Ninth General Assembly made by Senate bill No. 67 an appropriation of \$40,000 to further continue the work, and it is now being pushed as rapidly as possible.

COST OF THE WORK.

The amount of work done since the commencement up to and including May 31, 1893, can be seen by a glance at the following table:

	Acres.	Cu. Yards.
Clearing and grubbing.....	56.92	.....
Boulders removed from surface.....		3,124.4
Excavation—earth work of all classes.....		176,799.0
Excavation—rock work.....		17,116.6
Total.....		197,039.0

This, at fair contract prices ranging from 18 cents to \$5.00 per yard for excavation, and \$25.00 per acre for clearing, would have cost \$175,730.39, but has actually cost by using convict labor only \$76,843.02. The work so far accomplished on the canal has been of a very difficult character, there being a great many heavy cuts some being as deep 62 feet, and the soil being of such a nature that $\frac{3}{4}$ of it had to be blasted to move. This, of course, increases the cost, and at the same time makes the work necessarily very slow. In all there has been about three and one-half miles of ditch and flume, bed built and 1,160 feet of tunnels, one 750 feet long through a limestone and shale formation, and one 410 feet long through solid red granite.

It is impossible to fix the date for the completion of the work, but it is far better to have delay now than after crops have been planted. To avoid injury to prior appropriators a reservoir will be built at Twin Lakes, and water supplied from this source to ditches further down stream, when necessary.

The lands reclaimed by State sites No. 1 are capable of large and varied production, not only of ordinary farm crops but of fruit, as well.

THE BEAR VALLEY IRRIGATION COMPANY.

The embarrassment of the Bear Valley Irrigation Company culminated in the appointment of F. P. Morrison, president of the First National Bank of Redlands, as receiver, December 9. The plant of this company is one of the most splendid irrigation systems on the continent, delivering more valuable water to more valuable land than any other similar works, except those of Riverside. It was originally developed to furnish water for Redlands, Cal., which it trans-

formed in six years from a sheep pasture to a modern town of unusual beauty, set amid prolific orange groves. This is the company which contracted to supply the Alessandro and Perris districts, and its failure to fulfill all its obligations in this direction appears to be the immediate cause of the receivership.

THE AGE has studiously refrained from any discussion of the affairs of the company, because aware that its president, Mr. Charles W. Greene, was engaged in an earnest effort to avert disaster and provide means by which the creditors might be paid and the agreements with the two districts faithfully fulfilled. Now that the embarrassment has reached a point where the naming of a receiver could no longer be avoided, it seems necessary to allude briefly to the personal friction between the present and the former manager—between Mr. Greene and Mr. Frank E. Brown.

Mr. Greene charges that Mr. Brown, the originator of the enterprise, is responsible for the troubles of the company. In a circular of October 2d he disclaims personal responsibility for the financial policy of the company, asserting that he merely sold stock upon the representation of Mr. Brown and his associates, and that when, about one year ago, he assumed the management, he did so only because the step seemed necessary to all concerned. He charges that Mr. Brown has pursued a dishonest and selfish course, the object of which was to wreck the enterprise and then absorb it into a gigantic corporation of his own.

To this remarkable indictment Mr. Brown made no reply. He said he had done what he could to avert the disaster, and that he should patiently await the result, whether it be the restoration of the company's credit, or its collapse into the hands of a receivership. He said the people of Redlands and the American stockholders knew him very thoroughly; that he would invite a reputable Englishman to examine the charges for the benefit of stockholders in Great Britain. Mr. Brown has now broken silence by giving the following letters to the press:

CHICAGO, December 11, 1893.

To the Public:

I learn that the troubles of the Bear Valley Irrigation Company culminated on the 9th inst. in the appointment of a receiver. To those who are familiar with the part I had in the conception and upbuilding of the great enterprise which gave birth to Redlands and its surrounding development, it is unnecessary for me to express the deep regret I feel at this event, but to those who know of me only through the gross misrepresentations which have been circulated by various means during the past few months, it may be necessary for me to speak briefly but plainly.

I have refrained from speaking until now from a desire not to enter into a controversy which might be injurious to the interests of the company.

I devoted ten of the best years of my life to the development of the Bear Valley works. I have always regarded this plant as the most valuable and substantial irrigation property in the United States, in pro-

portion to the amount of land it covers. Although the project was regarded as very bold at the beginning, and although it encountered very many difficulties, physical as well as financial, my associates and I succeeded in our original object, and the city of Redlands is the monument to that success. When, at a later day, the company undertook to supply the Alessandro and Perris Irrigation Districts, we approved of the undertaking as feasible, and our good faith was pledged to its accomplishment. That the agreement in this regard was not fulfilled is no fault of ours.

While I regret very keenly the disaster which has overtaken the company I have no occasion to be surprised. More than a year ago I clearly saw the result to which the policy of the management would surely lead. My remonstrance was unavailing, and an aggressive effort made by me to induce foreign stockholders to agree upon the only possible course to prevent the ruin of the company was defeated by Mr. Greene, who, to further his own selfish purposes, has arraigned me as the enemy of that great enterprise which my faith and my industry largely created, and of that community which has been my home, and is to-day the seat of my property interests.

I have been assailed because I foresaw and had the courage to point out what must be the inevitable consequences of the policy pursued by a short-sighted and wrong-headed management.

I take this occasion to say again that the Bear Valley enterprise, if developed as originally conceived, is one of the most splendid irrigation properties in this country. Under proper management it will fulfill the expectations not only of its shareholders, but also of all who hold its water rights, including the two organized districts. If by any means in my power I can assist in solving its difficulties, thereby serving the communities in which my own interests are located, I shall do so with whatever energy or ability I may possess.

F. E. BROWN.

NEW HAVEN, CONN., September 15, 1893.

HON. JAMES GRAHAM:

DEAR SIR:—As you were for so long president of the B. V. & A. D. Co., and the Bear Valley Irrigation Company, and are conversant with the circumstances under which I came to this country, I am writing to you, at Mr. Brown's request, to state very generally the result of my inquiries here, so far as he is personally concerned.

This request seems to me a very reasonable one, in view of any possible accident which may happen to me on my way home. Time does not admit of my saying more than that (allowing for the mistakes of judgment which Mr. Brown may have made with others, in their joint conduct of the Company's affairs), I am satisfied after careful inquiry that Mr. Greene's charges against his personal honor are without foundation.

I may add that I am intending to enter into business connection with Mr. Brown, and that I look forward to that connection as one likely not only to be advantageous, but also an agreeable one in every respect. I am, dear sir, yours faithfully,

THOMAS CAVE,
4 Fenchurch Street, London, E. C., England.

THE AGE does not care to add any comments of its own to these statements, because it does not appear that any good purpose would be served by going into

the long and tortuous history of the affair. The Bear Valley Irrigation Company, whose great dividends dazzled the financial world, has failed as the result of very bad management. The thing to be desired now is to see the creditors paid, the water contracts fulfilled, and the stockholders protected as far as possible. If the time comes when *THE AGE* can lend any assistance in the realization of these desirable results it will gladly do so.

MR. ROWE AND THE BEAR RIVER SYSTEM.

The responsible management of the great Bear River canal system in Utah has recently passed into the hands of Mr. William H. Rowe, of Salt Lake City. This is an event of much importance to Northern Utah and of interest to the irrigation world at large. The Bear River works are among the most costly and substantial in the West. They represent a feat of considerable daring, both from a financial and an engineering standpoint. But it has been illustrated in this case, as in many another, that it is one thing to construct splendid works and another thing to develop the property and turn the assets, consisting of land and water, into gold.

The selection of Mr. Rowe as president and manager of the enterprise means that an effort is now to be made in a practical way. The choice is perhaps the very best that could have been made from among all the captains of the irrigation industry. The confidence of the local public and an intimate acquaintance with the history and character of the country, were in this instance just as important as eminent ability in the art of irrigation and the business of promoting colonization. Mr. Rowe knows Utah thoroughly, and, in a greater degree than any other man, he possesses the confidence of both the Mormon and Gentile elements in its population. He knows irrigation as a practical thing at home, and he knows it equally well as a student of literature and history. For years he has been an assiduous collector of books, pamphlets, and other printed matter, and he has about the best irrigation library in the country. The study of this literature has been his passion. It would seem that he had been unconsciously fitting himself for the work he has now assumed. *THE AGE* predicts his entire success in the work of colonizing the lands and developing, to the highest degree, the possibilities of the small, diversified farm.

Mr. Rowe has for several years been the assistant superintendent of Zion's Co-operative Mercantile Institution, which does an annual business of over \$4,000,000.

The lands of the Bear River Irrigation Company are among the best in the inter-mountain region, and produce everything in the line of farm, garden and deciduous fruit crops. They are in the neighborhood

of Brigham City, Honeyville, Deweyville and Willard City on the east, and the Malad valley on the west. Brigham City alone averaged eight hundred cases of fruit per day during the season of 1893. Thirty acres sown to alfalfa produced eight tons to the acre the second season, and the wheat record is forty-seven bushels to the acre.

With such material to work upon as this and with his splendid equipment of knowledge and experience, Mr. Rowe may be expected to make of this enterprise one of the most striking successes in the field of irrigation. *THE AGE* may present fuller particulars of the project at a later day.

IN SANTA CRUZ VALLEY, ARIZONA.

The Canoa Land and Water Company is the title of a new corporation with principal office at Tucson. The incorporators are C. W. Wright, J. H. Martin and C. H. R. Fitzgerald, the last named gentleman representing an English syndicate. It is learned that the new Canoa Canal has been bonded to them in the sum of \$100,000. The actual transfer of the property hinges on the confirmation of the Canoa land grant by the land court.

STORY OF THE GRANT.

The Canoa grant is generally conceded to be among the best, as to title, of the many now pending before the court. It dates away back from a Spanish king to one Ortiz and from him was inherited by his son. This son died recently at the good old age of about one hundred and ten years. Several years ago his interest was acquired by Messrs. Maish and Driscoll who have large cattle interests in this section. The grant is three miles wide by twelve miles long, located along the Santa Cruz river about thirty miles south of Tucson. Messrs. Maish and Driscoll originally intended taking out a small ditch in order to raise alfalfa, with which to fatten cattle for market, but as work progressed they saw the possibilities of their venture and enlarged operations, so that their main canal is now 100 feet wide on top, twelve feet wide on the bottom and fifteen feet deep. It is between four and five miles long. Work is still being pushed and will continue indefinitely. It is estimated that water will be developed sufficient to irrigate 25,000 acres.

The land is level, except for the natural fall of the river, which is about seventeen feet to the mile. The soil is a black loam, twelve to fifteen feet in depth, underlaid by sand, gravel and boulders, through which there is an immense flow of water.

This is only one of a number of promising locations along the line of the Santa Cruz river, which is mostly an underground stream. The valley only needs the attention of capital to develop its water supply, and convert to growing grain and fruit the soil which now furnishes sustenance to grass and mesquite.

The land that is now under cultivation in the vicinity of Tucson furnishes but a fraction of the hay, grain and fruit that is consumed by it alone, consequently the farmer who locates in this valley will get more for his product than in any other portion of the territory.

A land, in altitude from 2,000 to 3,000 feet above sea level, having twelve months of spring, summer and fall, where winter is never known, with 363 bright sunny days in the year—such is the Santa Cruz Valley of Arizona.

ARIZONA PROTECTS CAPITAL.

The Peoria Canal Company at Gila Bend, Ariz., has been put into a receiver's hands. Judge Baker announced an important policy when he named as receiver a person favorable to the defendant's interests, giving the following explanation:

"I have concluded to appoint Mr. McMillan as the receiver while the other gentleman whose names have been suggested here as representing their company are entitled to all respect; and while I have all confidence in them, yet, as it was aptly said by one of the counsel here, inasmuch as the money of the Peoria Canal Company and the Arizona Construction Company has built this magnificent piece of work and erected it out of a desert, and built it up, and the money is still in these works, and is still to go on building up the country by this irrigating canal, that fact should constitute a most potent reason that they should be permitted to name the receiver to be appointed.

They built the dam and the canal by putting their money into the work of its construction, and they have not yet got it out, and their money is in jeopardy; their dam is broken. I think in the appointment of the receiver if I lean one way or the other I should lean toward that policy which will not only cause them to feel that they are protected, but will enable the court to feel satisfied they will be thoroughly protected for their money. The fact that Mr. McMillan has been for a short time in the employ of the Peoria Canal Company is no impediment to his appointment."

ARTESIAN WELLS IN YAKIMA VALLEY.

A very hopeful development of artesian waters is under way in the Yakima Valley of Washington. The Yakima Land & Artesian Company has located a fifth well, and its manager is quoted as follows: "The wells all flow freely and the quantity of water is only governed by the dimensions of the hole drilled. The uplands of the Moxee Valley, upon which these wells have been struck, are generally characterized as the artesian belt; but there is no reason why artesian water should not be as plentiful

elsewhere in this section. We have every reason to believe that the whole of Yakima Valley is underlaid with the same strata; and this is taking 'Yakima' in its broad sense, covering all tributary and contiguous valleys. There is no doubt in my mind that in due course of time artesian wells will supplant, in a measure at least, surface water for irrigation purposes in this valley. And there are numerous advantages to recommend it. First, the water is of a very much warmer temperature than that flowing through the mountain streams, and this advantage will be obvious to experienced irrigators; second, the flow is continuous, thereby keeping the land moist and in condition for successful cultivation during the entire year; third, the expenses necessary in the long lines of ditches, for ditch-tenders, etc., are in a great measure obviated, and therefore the expenses are necessarily reduced."

A LARGE WASHINGTON ENTERPRISE.

About one year ago the contract for a canal about 100 miles in length through the richest portion of the Yakima country in Washington was let to Everest & Co., of Portland, and work has since been vigorously prosecuted under charge of W. L. Rockwell. This canal taps the Yakima river at Prosser, running thence parallel with the river until Kiona is reached. About two miles from this point two branches of the canal separate, one running north and the other south-east, thus irrigating over 130,000 acres of rich, heavy sag-brush land, about half of which is railroad land. The land gently slopes toward the Columbia River and is easily irrigated. Hops, fruits and vegetables can be raised as in no other portion of the State. The land now sells at an average of \$25 per acre and will be placed on the market as soon as the canal is completed, which will be in about six months. Two hundred men with teams will be put to work in a few weeks.

Yakima County is heavy sagebrush land, somewhat similar to that in Nevada, where three and four crops of alfalfa are raised in a season with the benefits of irrigation. Hops especially will grow here, and experiments have been made which were more than satisfactory. Under this canal the present season the first crop in a number of instances yielded over 1,000 pounds to the acre.

A despatch from the City of Mexico states that Engineer Scougal has signed a contract with Senors Vivanco, Sequin, and others of this city and the City of Nuevo Laredo to lay out large irrigation works to consist of a masonry dam above the junction of the San Juan and Rio Grande rivers and about 100 miles of canal and laterals, which will irrigate 25,000 acres of cotton land in Mexico.

TALKS WITH PRACTICAL IRRIGATORS.

THE WISE USE OF WATER.

BY CHARLES W. GREENE.

EXCEPT for grass and grain crops water should not be used by flooding, and it certainly should not be in the preparation of the ground for the planting of either of them.

There are certain crops upon which the water may be used with impunity, so far as touching the plant is concerned. Some of the stronger of the garden vegetables will not be injured by any use of water, while others will certainly be, if the water is allowed to touch the stem of the plant. I am making it an invariable rule, as a matter of safety, that the water shall not be allowed to touch any plant or the bark of any tree or shrub. Under the best circumstances, it does no good, and is certainly liable to do injury.

WATER ON THE SURFACE.

It should be remembered, too, that running water upon the surface of hard-baked land, or of rain-washed land, under a hot sun, will be attended with almost as rapid evaporation as it would be if poured upon the top of a hot stove, nor is its effect advantageous to the surface of the soil when so applied. If, on the other hand, the surface be broken so as to apply the water to the cool under-soil, the absorption is much more rapid and more thorough, and then, with the pulverized surface soil, no matter how dry, thrown back upon it, will serve to retain it there many times longer than it will if applied broadcast.

WATERING ALFALFA.

In watering alfalfa, if the water is applied about a week before cutting while the ground is shaded, and consequently cool, and especially if it is applied at night, the grass will be in very much better condition for cutting and will start more promptly after cutting by far, than to wait until after it is cut before watering. Then, if as soon as the hay can be cleared from the ground, a harrow be run over the surface to break the surface while it is soft, and there be another application of water, say two or three weeks after the previous one, it will certainly make a very great difference in the yield of the crop. One watering intermediate between this and the watering at cutting, will, I believe, invariably insure a good crop of hay.

MAKING THE FURROWS.

I have found one of the most useful tools that we have yet used to be the disc cultivator. With these land, in reasonably fair condition, can be thrown into ridges about four feet apart, either rounding ridges or sharp ones. In preparing our land we have found the

best results to come from throwing the ridges as high as possible, or at least leaving the dead furrows between as deep as possible and applying the water in these furrows. We run our furrows all the way across a forty-acre block, where the slope of the ground permits, running the furrow as full as possible until it has nearly reached the lower end, and there shortening the supply so as to run just as much as the ground will absorb by the time it reaches the lower end of the furrow.

A little stream left in this way for five or six hours will soften almost any of this ground so that it will mire a horse, and will use, in doing so, little more than half the water that would be required, if applied on the surface; and a good irrigator can run ten or twelve of these furrows at a time, and can irrigate more land with less labor, and more uniformly, than he can by flooding. With the same cultivator, with the discs straddling the dead furrow, the ridges of dry earth are thrown down over the water furrow as soon as it is dry enough for the teams to travel over it. Then, by harrowing the ground smoothly, the surface is left thoroughly pulverized and to a depth of six or eight is as mellow as ground need be for any crop. Ground watered in this way need not be watered oftener than once in six weeks, and no matter how hot the weather, moisture will be found within half an inch of the surface at any time, and plants will thrive in it. Of course, such ridges can be made by the ordinary plow, but not so cheaply.

PREPARING THE LAND.

We plant on the leveled ground with planters after this preparation, and there is moisture enough to bring any plant up and give it a rapid growth until it is from six to twelve inches high. As soon as the plant is large enough, we put the cultivators in for simple cultivation, throwing up as little ridge as possible. Two or three weeks later we run the cultivators through again, and then water in the dead furrows between, following watering by another cultivation with the discs set with a view to leveling down the ridges as much as possible.

There should, in my opinion, be at least one cultivation between the waterings, and two will be preferable. The finer the surface soil is kept the longer will the ground retain moisture, and the more mellow and pliable will it be to a depth of from twelve to eighteen inches.

My general rule would be, keep the water off the surface, get it underground from the outset; keep it entirely away from the plants, trees or vines, and use as little as practicable to keep the soil in good growing condition.

A NEW USE FOR CORN STALKS.

The American people are accustomed to surprises. Perhaps it would be more nearly correct to say that the American people can scarcely be surprised. New and wonderful achievements succeed each other so rapidly, and the improbable of yesterday so readily becomes the common-place of to-day, that we are prepared for almost anything. Experiments lately made by Mr. F. L. Stewart, seem to point to a revolution in sugar-making, although it may be that obstacles not yet encountered will finally intervene to dwarf or possibly destroy the apparent importance of his discoveries. It is nothing less than a method of making a merchantable article of sugar from common corn-stalks. The corn is grown as usual until the grain has arrived at the "milk" stage, then the ears are stripped off and the stalks allowed to stand a certain length of time when it is found that the amount of sucrose in them is doubled.

It is most definitely asserted by Mr. Stewart that corn thus treated will bear as high a percentage of sucrose as the sugar beet and, as is well known to all farmers, may be produced at a small cost—probably one-half or one-third that of the sugar beet. It will be seen that the ears are to be plucked at the time when they are most palatable as well as nutritious, and that there need be no waste in that respect if the corn be utilized to fatten stock. It is believed too, that the *bagasse* or crushed stalks may also be used as stock feed to a considerable extent, so that there will be but little waste of any sort, while the sugar extracted would prove a large gain to the farmer. While the IRRIGATION AGE cannot assure its readers at this time that these discoveries of Mr. Stewart will necessarily lead to the wonderful results predicted by the enthusiastic experimenter, yet a short review of the situation, showing the enormous opportunity for a possible industry of this kind, may not be out of place.

While the people of the United States do not consume as much sugar, per capita, as do those of one or two other countries, yet they consume, in the aggregate, about one-half of all the sugar produced on the earth. For the calendar year 1892, our imports of sugar and molasses amounted to \$108,053,167; and for the fiscal year ending with June, 1893, the value of sugar imports reached the stupendous sum of \$116,947,430, of which \$12,846,509 represents value of the beet sugar brought in from other countries.

While the area of land capable of producing the sugar beet with a profit is very large in the arid zone, and with the present stimulus of government bounty might soon be made to meet a large part of our sugar demand, yet should the bounty be discontinued as proposed, the industry might not be able to expand. With this contingency in view it is timely that experiments be made with other crops, as above indicated.

A crop that is of the greatest advantage as forage, which yields sugar in commercial quantities besides, must be regarded as of the utmost value.

Sugar beets in Nebraska and California yielding about 12 per cent. sucrose bring, at the factory, from \$4 to \$4.50 per ton with a certain bonus for each one per cent. of sucrose above 12. The average being somewhat above the standard, the beets grown the present year have averaged somewhere near \$4.50 per ton, though at the Watsonville factory in California the price has been uniformly \$5 per ton for select beets. In suitable locations the cultivation of beet roots at these prices has been found to be a profitable business, and lately several hundred acres of land were sold to tenant beet farmers, at Chino, Cal., at prices averaging \$150 per acre. It is presumable that the men who bought the land knew its worth, having raised one or two crops of beets on it before purchasing.

If then, good beet land is worth \$150 per acre, good corn land should be valuable if any sugar-making enterprise in connection with corn culture shall be perfected.

That the United States should depend upon foreign countries for seven-eighths of the sugar consumed is scarcely creditable to our industry and ingenuity, and the stimulation of home production of that necessary of life should be urged by every proper means.

Cannot we in some measure account for the present hard times when we reflect that the American coffee cup, to say nothing of the cream used, cost us for the year ending with June last, the sum of \$257,240,167.

A NEW WEIR SYSTEM.

Southern California has been the field of many improvements in irrigation appliances. A fruitful source of trouble has been the lack of an equitable plan for dividing the water among the parties entitled thereto. In nearly every irrigation canal the conditions are identical, to-wit: A certain amount of water to be divided in varying proportions among a certain number of irrigators. In nearly every instance consumers are expected to bear their proportion of loss by seepage and evaporation between the head of the main canal and their respective gates. This loss is a varying one, being so great on a hot day that if each gate is set to take its quota without shrinkage, the man at end of the system seldom has enough to drink.

The West Highlands Water Company in San Bernardino county, Cal., is putting in a system of weirs which will completely avoid this difficulty. Their main ditch is one mile in length with six lateral branches each the same length. At the head of the first lateral the ditch expands into a large cemented basin having two outlets, one opening into the main, the other into the lateral. In each opening is set an iron gate of ample width and height and having a

sliding door, which may be opened sidewise to any given width and fastened at that point. Both gates are exactly on a level. The weir at the head of each succeeding lateral is an exact duplicate. Five weirs suffice for the six branches, the fifth one serving for two, being at the last point of division. The distribution of the water is so arranged that but one consumer has water in and certain lateral at a time.

Under this arrangement the zanjero, starting at the head of the main line with say 600 inches of water to be divided equally between the six laterals, goes to the first weir and sets the gates in the ratio of five for the main to one for the lateral, and so on, the gates in the last weir being set equally open. Measurements to ascertain the amount of water are made on the open weir basis. Under this arrangement it will be seen that any decrease, and likewise any increase, in the flow is automatically and equitably divided between all parties on the system.

The gates, which are not patented, are the invention of W. M. Bristol of East Highlands, under whose supervision the weirs are being built.

DEVELOP THE SPRINGS.

BY J. M. GOODWIN.

Sometimes a word or thought expressed to the inquiring mind may lead to good results. Riding in a train a few days ago a gentleman, who has spent a long life as civil engineer began talking of the possibilities of the arid lands we are traveling over in southwestern Idaho. "Water," said he, "is the great thing. It may be developed sometimes where you would hardly expect at least such abundance."

One of our party said he had found a very small spring on his land, and he wished it would open out big enough to be of use.

"Why don't you help nature to do that?" said our engineer. "Let me give you an example. I was surveying some years ago in Texgs. A small spring and its basin into which the water flowed supplied the cattle with water. The animals stood in the basin and tramped around the spring until they crushed out the flow, and the cattle had to go without drink. I urged the cowboys to dig until the water was started again. They did so and secured a larger flow than ever before. The number of cattle greatly increased, and, more water being needed, the excavations were extended, and within a year or two the spring increased its flow so much that the owner put in a small race and had water enough to run a small saw-mill. Springs are mostly artesian in character and can be, as a general thing, increased in quantity by giving them more freedom in discharge."

Now is a good time to trace and open springs. During the heated term, when the air of the arid regions

take up moisture so rapidly as to exhaust small springs before the water passes many feet on the surface, and numerous others before coming to the surface. Small springs cannot be easily found and traced. There are very many such which in July and August did not show even signs of moisture, which now, that cool days have come, are sending out strong streams of water and, mingling their flow together, have filled the brooks with the clear, sparkling fluid.

The writer could mention many incidents where a few feet of an open cut or tunnelling into the hill has developed large flows of water. A tiny spring in the northern portion of Salt Lake City a few years ago sent out a little hot water to be taken up like a spring by the dry air before it had gone many feet. The owner tried the experiment of tunneling in some twenty, or thirty feet through limestone. A portion of the water thus developed is now pumped up into a tank eighty feet above and it then flows about two miles through an eight-inch wooden pipe to a sanitarium in the heart of the city and delivers it there with a temperature of 108 degrees. Were it not for the tunnel that spring would not have been known except to a few and its great value would have remained unheard and its praises unsung.

The drill that pierces the earth to a depth of a thousand feet and taps a generous flow of water is only performing the same service that a tunnel run into the hill may do, and often the tunnel is the cheapest, most simple and effective.

AN OLIVE OIL PLANT.

Howland Bros. have just received their new and expensive oil machinery and have it in place in their new building in their olive orchard near North Pomona. They have a gasoline engine for power. The olive press weighs 18 tons and is operated by hydraulic power. Two hundred pounds pressure is provided for. The crusher weighs 2,200 pounds. The building and machinery are constructed specially for making olive oil.—*Pomona Times*.

NEEDLESS IMPORTATION.

Peas, barley and alfalfa are so easily and luxuriantly grown in all the valleys of Central and Western Montana that it is a matter of surprise that so few ranchers engage in hog raising. As much pork is probably consumed in mining camps, per capita, as in any other region; yet Montana depends for its supply upon Chicago. Home hog-raising for the Northwest is as important as "home rule" for Ireland.

The residents of Wild Flower, Cal., are reported as planning to irrigate 40,000 acres. J. J. Schlitz and J. R. Smith are interested.

THE MIDWINTER FAIR.

The Pacific coast region is fully aroused to the great advantages to accrue from a grand exhibition of its resources at the Midwinter Fair, to be opened at San Francisco in January, and to continue until July. The magnitude of the enterprise long since assumed proportions beyond the original conception of its promoters, and it continues to expand in a manner quite surprising even to those who have the fullest faith in the ability of that sunset realm to achieve wonders when fully awake to the importance of the event.

While making no pretense to equal, or even nearly approach, in magnificence, the great exposition just closed at Chicago, yet it will certainly rank high as an exposition, either national or international. The first spadeful of earth was turned on August 24th, and by the time these lines appear in print there will be ready for occupancy, by the manifold exhibits, some of the largest and finest buildings ever erected for such purposes in this country outside of Chicago.

Over thirty different nationalities will have extensive and characteristic exhibits, and the number of buildings will exceed seventy. The principal structures are those of agriculture and horticulture, manufactures and mechanic arts and the fine arts, each of great size and of pleasing architectural design.

The site of the Fair, as many readers of *THE AGE* are aware, is in Golden Gate Park, a short distance from the heart of San Francisco, and within view of the broad Pacific Ocean and the Golden Gate. To those of the farther West who missed the great occasion of the century—the Chicago World's Fair—the California exposition will afford the next best opportunity to witness a great aggregation of the world's wonders on this continent. A vast number of the most attractive exhibits at the Chicago Fair have been transferred to the Pacific shore and are now being installed, flanked by the best that can be produced in the wonderful region which to-day stands as a partial fulfillment at least of the ultimate dream of irrigation. It may be truthfully said that the achievements which have made the California Fair a possibility would not, and could not, have been wrought in that comparatively new and undeveloped region of our country, save through the successes reached by the development and practical application of irrigation as a prime factor in the cultivation of the soil.

While the State of California yields some \$12,000,000 to \$15,000,000 in gold, annually, from her mountains and river beds, yet the golden shower which falls most copiously upon her people, comes as the leaping cataract from the mountain heights, which, when directed upon the broad mesas and smiling valleys below, by its magic touch transmutes all the gold. Let the products of their mines be what they may, it is to their soil, legitimately and happily wedded to the mountain

waters, that a great part of the coast and mountain States must look for that wondrous development which future years are certain to witness throughout the arid belt, from Texas to North Dakota, and from Kansas to the Golden Gate.

The great enterprise which is now so auspiciously culminating at San Francisco will be found to be, after all, but a pioneer, pointing the way to still greater achievements in the near future and beckoning the arid mountain States to follow her in the grand march of progress toward the setting sun.

What California has achieved is possible in other States and Territories, and the first half of the next century will usher in a revolution, if not, indeed, complete it, in the arid belt, more far-reaching and beneficent in its consequences than any event which has blessed the world since the discovery of America.

For the inspiration and added courage it will give, every resident of Arid America who can possibly do so, should visit the Midwinter Fair. On the route will be seen the difficulties to be overcome and also the results flowing from persistent and well-directed effort along the proper channels. Object lessons line the route and the Fair will prove the happy culmination of imagined possibilities. It will impress every mind with a keener sense of the true greatness of our vast country and inspire the visitor to higher resolves and to better appreciation of the responsibilities and privileges of American citizenship.

FARM NOTES.

It has been established by chemical analysis and otherwise that about ninety-seven per cent. of the constituents of all trees and plants is made up from water and from the various plant foods found in the atmosphere, while only three per cent. is derived from the soil.

MUCH interest is manifested in irrigation enterprises in eastern Oregon and Washington. It is reported that a large amount of eastern and foreign capital is flowing that way, and that the developments in that section of the arid northwest during the next few years will be phenomenal. The favorable transportation facilities to eastern markets, enjoyed by the two States named, should materially aid in their development on irrigation lines.

As an all-round fruit-producing region it may be safely said that an arid country with good irrigating facilities stands immeasurably above a region of haphazard rainfall. The curing and transportation of fruits, and the cultivation of them as well, are greatly facilitated by a dry atmosphere. Water used in proper quantity and at proper times is found to add greatly to the quality of fruit as well as to the quantity, and to insure this the orchardist cannot safely depend upon the natural rainfall.

HORTICULTURE BY IRRIGATION.

FRUIT-GROWING IN UTAH.

BY JOEL SHOMAKER.

FRUIT-GROWING under proper climatic conditions, and with skillful management, is always a paying industry. The fertile valleys of Utah offer superior inducements to the energetic horticulturist who will plant them to fruitful trees and vines. Water, soil and climate are correctly proportioned and await the co-operation of capital and energy to transform the deserts into wealth producing orchards and vineyards. The mountains tower on either side of these valleys, as vigilant sentries, guarding the watersheds and warding off the attacks of destructive blizzards, tornadoes and cyclones.

WHAT HAS BEEN DONE.

A few men of foresight and judgment have interpreted the fingermarks of nature and grasped this opportunity to obtain wealth and independence. In Grand county some of the most wonderful fruit productions are recorded. At Moab one man has a vineyard of three acres from which he harvests over \$2,000 worth of grapes annually. Another owns a small peach orchard, of perhaps one acre, from which he has sold over \$1,500 worth in one season. I have plucked peaches from this orchard that averaged nearly fifteen ounces each, by the basketful. Many of the finest specimens weighed over one pound each. Apples grown in this valley weigh as much as twenty-three ounces each. The quality is excellent, and wherever exhibited, this fruit sells at a premium above all imported varieties. Other fruits grow with equal prolificness.

Moab is not an isolated instance of the superior advantages offered fruit growers in Utah soil and climate. In Little Castle valley, another beautiful garden of the Grand river valleys, equal results have been obtained. Even figs and other semi-tropical fruits flourish and produce abundantly. Emery county produces apples, peaches, pears, grapes and small fruits that are beyond comparison with imported fruits of similar varieties. Utah county, with her luscious strawberries, delicious peaches and beautiful apples, has long since demonstrated that the State can produce an abundance of choice fruits. Salt Lake, Davis, Weber and Box Elder counties are dotted with fruitful orchards, and plats of strawberries, blackberries and raspberries that never fail to yield enormous returns to their owners. The famous "Dixie Land" comprising the counties of Millard, Washington and Beaver, is known as the land of the grape.

THE INDUSTRY NEGLECTED.

But fruit-growing in Utah is a much neglected industry. While a few men devote proper attention to

the business, and reap beautiful harvests, the general application is yet in the future. Small fruit farms, of ten to twenty acres, conducted upon the proper basis, are needed to develop the country. There is no good reason why several thousand acres should not be planted to small orchards and vineyards, and made to yield \$1,000 per acre, with absolute certainty, every year. This would insure employment to a large army of men, women and children, and add immense wealth to the territory. The field is open. The natural advantages are everywhere present. Young men, middle aged men and even old men are wasting their days at unremunerative work while nature calls them to labor in her most prolific vineyard.

POSSIBILITIES OF CHEAP LAND.

Land that now produces nothing but native brush, can be purchased very cheap. Water rights in canals already constructed, cost but little in comparison with the benefits to be derived. New reservoirs and canals can be built and water secured to subdue the entire desert area. The Rio Grande Western Railway passes through what should be a perfect fruitvale, from Grand Junction to Ogden. A large majority of this area is comparatively unoccupied. The waters of the Grand, Green, Price, San Rafael and even the Jordan rivers pass by unutilized, what should be the habitations of thousands of contented and wealthy fruit growers. The projectors of this road no doubt foresaw the day when the natural reservoirs of the mountains would be utilized in impounding waters, the canals and laterals would be constructed in every valley and, by the never failing powers of irrigation, the deserts would become the homes of thousands, who would be shipping choice native fruits to the east and the north, every month in the years. Such are the possibilities of every valley through which this "Little Giant" daily carries its burdens.

TRY CALIFORNIA METHODS.

How can this be accomplished? In the same manner that the great fruit growing districts of southern California have been planted. By organizing colonies of fruit growers, by planting small tracts of ten to twenty acres, as much as one man can manage, by co-operation in securing water rights, planting the trees and vines, and marketing the products. The famous colony of Anaheim was settled by clerks, school-teachers, mechanics and others who worked at their trades or professions, and employed experienced men to plant and cultivate the vines till they were in bearing. When the ten-acre tracts were producing sufficient to give a family a comfortable living the owners, who were out but a small proportion of their savings, removed to their own tracts, and have since become

independent of managers, directors and money sharks, who made their lives miserable while they were merely employes of others. Men and women of Salt Lake City, Ogden and cities of the East and the West, can do the same and be assured of attaining similar results. Where is the land? Within the shades of the smoke of Salt Lake City, Ogden and Provo; in sight of the railway between the Weber and the Grand rivers, and within the hearing of the fast express trains, ready to carry the products to market. Where is the water? In the snow crowned mountains, with their perpetual reservoirs, overshadowing every valley; in the numerous rivers rushing by, and whispering gently to the enterprising fruit grower. Here am I use me; and in the vast underflow whose hidden fountains are an unknown but evident unlimited quantity. The water resources cannot be exhausted even though the entire desert area comprising hundreds of thousands of acres, be reclaimed and brought under cultivation.

MATERIALS OF THE INDUSTRY.

Native trees and vines can be purchased at the home nurseries of Salt Lake City and Ogden at reasonable rates. Implements for preparing the soil for planting are sold in the same cities. Materials for fences, farm buildings and dwelling houses are within the limits of the Territory. The railways have been constructed for the purpose of transporting such articles. The work of clearing the land, plowing, leveling and making ready for planting can be performed every day in the year, with practically no inconvenience from heat or cold. Canals, mains and laterals for conducting the water to the land and properly distributing it, can be constructed by machinery manufactured and sold in Salt Lake City. Planting of trees and vines can be done in the fall or spring with an assurance of success.

RAPID GROWTH.

Within three years after planting the grape vines will be in bearing, and the fruit will pay good dividends upon the investment. Two to four years later the trees will yield fruits, and where then is there a savings bank, bond investment, endowment life policy or mercantile institution that will return the interest and dividends that can be obtained from these vines and trees? In the meantime while the fruit is coming into bearing the cultivation of the land between the rows of trees will yield ample corn, potatoes, sweet potatoes, peanuts, melons and vegetables to enable the owners to live independent of wage earning. A Kansas farmer recently sold the fruit of a forty-acre apple orchard for \$4,500—equal to ten per cent. on a value of \$450 per acre—and never so much as entered the orchard while the purchaser was picking the fruit. This can be done in Utah.

The market for green and dried fruit, raisins and wine is without limit. When a few hundred acres of

orange trees were planted only a few years ago in what is now Riverside County, Cal., croakers began to cry overproduction, and some were anxious to sell their farms at any price to leave the country, where every person wanted to grow oranges. The total acreage in that small county now approaches 13,000, and more trees are being planted. The shipments from Riverside alone in 1880 were fifteen carloads, and some people thought that the market would be overloaded. The shipments of oranges from that place in 1893 are estimated at 2,000 carloads, or 572,000 boxes, and still the market cannot be supplied.

Utah soil, Utah climate, Utah water resources and Utah shipping facilities cannot be surpassed in the entire inter-mountain region. The fruits already produced are superior to anything of similar varieties placed upon the market. Are there any reasons why Utah should not become one of the most famous fruit growing States of the West? None, except the lack of enterprise, industry, co-operation and capital.

FRUIT GROWERS SHOULD STAND TOGETHER.

The effort now making to unite the producers of California fruit, both of the citrus and deciduous varieties, in an effective organization for the sale and distribution of their products, deserves the co-operation of every grower. The success of the organization is the indispensable condition of prosperity. The facts in the case are very simple.

Fruit growing has been, and should continue to be, a profitable industry under irrigation. During the past year there has been a shrinkage in prices paid the producer entirely unwarranted by the situation. The cry of overproduction has been analyzed and fails to account for the reduction in prices. THE IRRIGATION AGE has been at some pains and expense to investigate the matter, and finds that consumers are paying very high prices for all deciduous fruits in the East. Inquiry made by a representative of THE AGE in Cincinnati, Washington and Baltimore, in New York, Philadelphia, Detroit and other important points, demonstrates the fact that all the dried fruits are selling at from 25 to 30 cents per pound—three times the average price paid the grower during the last season. The cost of transportation from the point of production to the place of consumption is less than 2 cents per pound.

Thus the shrinkage in prices is due neither to overproduction nor to railroad extortion. It is due to a system of organized robbery devised and carried out by middlemen. They rob the producer at one end and the consumer at the other. The result is that the market demand for these products is curtailed, and that the purchasing public is compelled to get along with much less of this palatable and nutritious food than it would naturally require. In a future number THE

AGE will discuss the matter in all its bearings, but it desires to say now with the strongest emphasis that fruit growers should cooperate heartily in building an organization whose agents will distribute their products, and secure to them their fair share of the price paid by the public.

IRRIGATION OF SMALL FRUITS.

At a recent meeting of the State Horticultural Society of Indiana, the subject of irrigation was the most absorbing topic of discussion. It is only the location and not merely the fact that makes this an interesting circumstance. That the question should, for a moment, engage the attention of a horticultural society in Indiana is of itself a matter of great significance. The question was not only discussed exhaustively in a general way but certain members recounted their late experience in the practical operations of irrigation as applied to crops of berries. One member states that a patch of blackberries near Muncie had been properly irrigated and produced an astonishingly heavy crop, while other patches taking their chances with the natural rainfall had dried up on the stalks and proved a conspicuous failure. In view of the experience of certain advanced growers in various parts of the State it was the sentiment of those best informed that irrigation is a practical necessity in successful berry culture in most parts of Indiana. What is true of Indiana will apply equally well to Illinois, Ohio, Michigan and several of the Mississippi Valley States. Water was applied, in the case mentioned, by means of a pump, and the grower found, that the berries produced, by virtue of the water, this year, more than three times paid for the cost of irrigating appliances.

It is well known that in most of the States of the middle west a drouth of greater or less severity is almost sure to occur at some time during the crop season, and to provide against its blighting effects should be the care of every farmer who has land and water which may be united at the proper times without too great cost.

Celery growers in Michigan have found that an irrigating plant is a necessary part of the outlay in establishing a celery farm. Even in these localities where water is only three or four feet below the surface, irrigating pumps moved by horse or steam power are used with great advantage. A crop of berries or vegetables which has been supplied with moisture in proper quantity and at the proper seasons is certain to develop greater uniformity of excellence than would be possible under the spasmodic weather conditions mostly obtaining during the growing season in all the older States. While cultivation may to a great extent obviate the use of much irrigating water, yet on many of the soils in the Mississippi valley no amount of

cultivation will wholly avail in the absence of water. It then becomes a question of more moisture or a loss of crop. It may, therefore, upon the whole be regarded a hopeful sign when horticulturists admit the necessity of irrigation, even if they do not regard it feasible in a given case. It is probably not too much to hope that irrigation of small fruits will soon be deemed a necessity in the region under consideration, and that irrigating plants of some sort will soon become a permanent feature of the best-tilled farms of the Mississippi valley. THE AGE will discuss this subject in future issues and will be able to give valuable advice to irrigators in any part of the country.

NEW CONSTRUCTION OF DESERT LAW.

The register and receiver of the Santa Fe land office are in receipt of special instructions from the general land office of no little moment to those who have made entries under the desert lands. Under the old act of March 3, 1887, entrymen are allowed three years to perfect their claims, but as it was amended by the law of March 3, 1891, settlers are allowed to apply to their local land office for one year's extension of time. The party making such application will be required to file a sworn statement of his intention to proceed under the amendment act, showing what has been done by him toward improving the land, and setting out that since he has determined to proceed under this amended act he has complied with all of its provisions. He must also file a map showing the contemplated plan of irrigation of the land.

But when final proof is made the claimant will be required to show the expenditure of at least \$3 per acre and the cultivation of one-eighth of the land, as well as the permanent reclamation of the entire tract.

A VAST POWER.

An artesian well opened up at Chamberlain in South Dakota some time ago, is credited with a flow of water thrown fourteen feet above the surface, of 8,000 gallons per minute. That would constitute a pretty fair sort of small river. It is the largest in this country, and, it is believed, in the world. The one at Huron delivers 3,000 a minute, and was regarded as a big thing. Most of the artesian wells in that State are in the James valley, but Chamberlain is on the Missouri, as is Pierre, which has several fine wells. These subterranean waters seem to underlie the whole State, waiting for opening to serve its people. What that service may be in the coming century even a dreamer could not now picture. Among the earliest suggestions would be a vast power for manufacturing and mechanical purposes, then a system of irrigation that will render the farmers good crops every year.—*Northwestern Farmer.*

WATER POWER AND ELECTRICITY.

THREE GREAT FORCES.

THERE is a great work to be done in the department of water power and electricity during the next few years, and the scene of its most active development will be in the far West. Study the topography of the western half of the continent, with its mountains, valleys and streams, and it will be instantly observed that, in comparison with all other sections, this must be pre-eminently the field for expansion of cheap power harnessed to electricity and applied to the manifold uses of industrial and domestic life.

Irrigation, water-power, electricity—a trinity of forces with potentialities of growth whose further boundaries the wisest cannot locate, but whose tremendous possibilities are vaguely apprehended by all who appreciate the variety and extent of western resources. It is believed that 1894 will see substantial progress toward results in this field. THE AGE can do much to point out the location, character and extent of water-power in the West, to indicate how they can be utilized with the aid of modern appliances, and to show the relation which exists between the three great industrial factors, which nature and inventive genius have placed in juxtaposition.

WHAT HAS BEEN DONE.

A very vivid illustration of the possibilities of this development is furnished in the following description, from a reliable source, of what has been done at Great Falls, Mont.:

"At Black Eagle falls, three miles above the town, an immense dam has been thrown across the Missouri, and hydraulic works and power houses erected. Not only are the street cars propelled and lighted by electricity from the power-houses, but they are heated as well by electric radiators placed in each car. Elevators, printing-presses, cranes, and all kinds of machinery are operated by the ubiquitous force. There are automatic excavators, electric pumps, and electric rock-crushers. A not uncommon sight on the streets is a mortar-mixer attached to an electric wire leading down from a pole. The restaurants cook by electricity, the butcher employs it to chop his sausages and hamburger, and the grocer to grind his coffee, and so likewise does the tailor to heat his goose. The subtle fluid is a welcome blessing in every home; the housewives run their sewing machines and heat their flat-irons by electricity; they bake their cakes in wooden electric cake-ovens that can be set away on shelf like pasteboard boxes. They have electric boilers and broilers and tea-kettles. What a singular anomaly, when one pauses to think of it—that of broil-

ing steaks and heating flat-irons through the instrumentality of a waterfall!"

COOKING BY ELECTRICITY.

The feature of this, possessing the first interest to the average household, is that which relates to the furnishing of heat for domestic purposes. Everybody is familiar now with electricity as applied to light and power, but there is still reserved the sensation of eating a breakfast cooked by electricity in a room heated by electricity. A recent demonstration in New England is described as follows:

"Think of an oven for this purpose so constructed that, without fire or flame, by the turning of a regulating switch, any desired degree of heat can be obtained! Through a glass window in the door of the electric oven, which is illuminated by an incandescent lamp, the contents of the baking chamber can be clearly seen. An attached thermometer gives the exact degree of heat in the oven. Meantime the heat which is generated close to the inner walls of the baking chambers, is so insulated that the nickel-plated exterior of the oven is not raised to a temperature sufficient to burn the hand. With interest and profit can the entire process of baking be watched and studied. Such apparatus as this bids fair to make the study of cookery a fascination and a delight.

"The epicures who have delighted in the expiations of Mr. Edward Atkinson over the merits of his "Aladdin oven," and who have enjoyed even more, the products of the oven itself, will take a double measure of joy when they know that the lamp used therein to maintain a prolonged, mild heat, can have substituted for it the economical, odorless electric generator, operated as easily and reliably as the familiar incandescent lamp."

UTAH IS ALIVE TO IT.

Utah is abundantly blessed with water-power facilities and the recent formation at Ogden of the Pioneer Electric Power Company has created a widespread interest. The company has a capital of \$1,000,000. Its objects, as set forth, are, the acquiring, storage and utilization of the waters of Ogden river for the purpose of deriving power therefrom, and the acquirement of land and the use of water for irrigation; the use of the power for manufacturing for railways, heating, lighting, and other uses, either by electric transmission or otherwise, the acquirement of franchises in cities and towns to operate railway lines, water and power plants, heating, lighting, etc.; the business of operating said plants and the sale of power to other corporations or individuals and the use of the water for irrigation, domestic and other uses.

THE MAKING OF COLONIES.

THE INDISPENSABLE COLONIST.

THE one branch of irrigation promotion with which the managers of enterprises have not successfully grappled is that of finding colonists to settle their lands. And this is the indispensable requirement, too. The stream may be diverted, the canal built, the water brought to the corner of the farm, but unless there is then a settler to apply that water to the land and develop the possibilities of the soil with his brains and brawn, the enterprise cannot realize the hopes of its projectors. There are many irrigation projects scattered all over the West that illustrate the importance of this missing link in the chain of development.

WHERE THE TROUBLE LIES.

There are numerous reasons for the difficulty thus far experienced in the colonization of irrigated lands. The first and foremost is that the great public, at home and abroad, from which settlers must be drawn has not yet been brought to understand the strong attractions of the irrigated farm. Not one man in ten—perhaps not one in a hundred—of the millions in the East has the slightest comprehension of the deep economic significance of irrigation. The subject is new to all except the people of the West, themselves. There must be a widespread and general appreciation of the subject before colonists will move readily to the new West.

The second great reason lies in the fact that promoters of irrigation projects have not themselves grasped the real meaning of irrigation as it affects industrial and social life. With few exceptions, they have not planned model colonies, or sought to show their settlers how to achieve the best results of the small farm. There are those who rail at the "men of song and story," who insist on the necessity of making the very best use of all the opportunities and lifting the irrigated farm and the town which serves as its center to the very highest available standard. And yet the matter is really not open to dispute. Brigham Young planned, with his capacious brain, a scheme of industrial prosperity for his followers. They succeeded. The founders of Greeley insisted on the best standards for everything; the colony-builders of Southern California did likewise, and distinguished success came to them all. Now, there are in Utah, Colorado and California, to-day, large irrigation plants whose managers ignored these examples and simply threw their lands upon the market and left the settlers to plan for themselves. They have the same soil, climate and other conditions as the examples referred to, but thus far they have not succeeded in transmuting their water and land into that hard cash that measures

the final result. Argue as long as you please, and these facts will still stand out as plain as the sun at noonday.

PROMOTE THE IDEA.

Those who are interested in having irrigated lands speedily colonized with a good class of people have two duties. The first is to give hearty support to whatever will bring home the irrigation idea to the country and the world. Let them study the article published elsewhere on the irrigation propaganda and resolve to stand by the organization that has it in hand.

Let them have no foolish fears about the effects of the Los Angeles declaration concerning water ownership and the desert land law. Those principles are eternally right and the men of the West—God bless 'em! are going to see that they prevail, but they will not affect the present owners of irrigated lands in any way whatever, except favorably. Money has never been made out of the sale of water in the long run. Nowhere has it been possible to "sell water" for more than it has cost to deliver it. Money is made from the sale of land, and if the present movement makes less easy the acquirement of arid public lands in large tracts it will have a favorable influence upon the sale of lands already reclaimed.

Owners of irrigated lands have everything to gain from this organized movement to arouse the country to the possibilities of a new civilization. They should back that movement with their money and their brains. If they do they will find it easier to sell their land one year hence than they do to-day, and very much easier in two, three and five years than in one.

WORK OUT MODEL PLANS.

The second great duty of land owners is to assist in making 1894 a notable year in the development of attractive colonies. The leaders of irrigation thought will do the preaching with pen and tongue, but the proprietors of land and water enterprises must furnish the practical illustration of what can be done on small farms under irrigation. They should vie with each other in making plans that will attract men and women from the wornout farms of the East and the semi-starvation belt of the middle West, from the factory, the counting-room and the Government departments. THE AGE will gladly give space for the description of these plans. Irrigation philosophy is certain to occupy large attention during the coming year, but irrigation practice can be made to keep step with it if progressive companies realize the responsibility that rests upon them and the benefits they may realize from the performance of it.

PUBLISHER'S DEPARTMENT.

LOOKING FOR A HOME IN KERN DELTA COLONIES.

AN eastern man recently wrote to a friend traveling in California concerning the chances for settlers in the Kern Delta Colonies, and received the following instructive reply:

SAN FRANCISCO, December 15, 1893.

LORIN JOHNSON, EUREKA, ILL.:

MY DEAR SIR:—I just returned from Bakersfield, Kern county, and other places in the San Joaquin Valley, where I have been investigating the prospects for establishing a colony in accordance with our plans made before I left Illinois. I have met a great many people who are familiar with the prices of irrigated lands and the profits derived therefrom in Colorado, Utah, Idaho and all parts of California.

BAKERSFIELD.

Bakersfield, the seat of Kern county, is about 300 miles south of San Francisco on the Southern Pacific Railroad, and nearly 200 miles north of Los Angeles. It is near the head of the great San Joaquin Valley, and this valley, as I wrote you before, is nearly one-fourth as large as the entire State of Illinois. There is no doubt but there will be another railroad built to this place soon and a canal will ere long extend from Stockton toward Bakersfield, thus giving good shipping facilities for the product raised in this county. The climate since my arrival here has been such a contrast to the climate of Illinois during this season of the year that I much prefer remaining here until next spring. Bakersfield is a new town about five years old, but they have much better building than any county seat I have seen in Illinois. It is the most important one now between Fresno and Los Angeles, and many think that it will in ten years be the largest town in the great San Joaquin Valley.

KERN DELTA LANDS.

I took a ride over the lands of the Kern County Land Company and was surprised to find such a large body of fertile soil located in

such a genial climate still unimproved, while there are thousands of families in Illinois who work hard through six months of the year in order to produce enough to keep them during the winter. Here the farmers can work almost every day in the year. They have no dread of severe winters, nor does the soil require so much cultivation in order to produce a good crop, as a large amount of the Illinois land does that has been cultivated for twenty years or longer. Then the farmer or fruit grower in Kern county has no fear that he will not have a sufficient amount of rain during the spring months to give his crops a good start. Neither does he worry about the excessive rain during the summer months to destroy the crop when he is harvesting it. He simply controls the water question by turning the necessary amount from the ditches when the growing crops need water and turning it off when they have a sufficient amount. If our friends who were first opposed to locating on irrigated land could spend one day here in harvest time and see the farmers cutting their grain in one field while in the adjoining vineyards and orchards the water was running down the furrows to irrigate the vines and trees, they would soon learn the advantages of irrigation and what a poor substitute rain is when compared with the artificial application of water to all crops produced by the farmers.

FROM THE SETTLER'S STANDPOINT.

Now in regard to locating in Kern county, I find that we can purchase land here at from \$60 to \$100 per acre, depending on the location and surroundings. If any of our friends prefer leasing lands until they dispose of land in Illinois, or until they are thoroughly satisfied with the prospects in Kern county, they can obtain them by paying seven per cent. on this valuation. When ready to purchase they can obtain the land by paying one-fourth cash and the remainder in three, four and five years at the rate

mentioned. Now, you know that in Illinois the man who rents hay land obtains one-third of the crop for harvesting it. In Kern county they get five crops of hay each year from their irrigated lands, which is worth from \$5 to \$10 per ton, and the land produces about two tons per acre at each cutting. So you will see by leasing hay land here and paying therefor from \$4 to \$7 per acre that the first crop will bring enough money to pay the lease and the other four crops will be for profit after deducting expenses. This land will produce from forty to sixty bushels of wheat per acre though it was difficult for me to believe at first that this statement was true, but after such inquiry I failed to find a farmer who doubted this statement. Peaches, prunes, apricots, pears, etc., do well here. All these will pay expenses of cultivation the third year from setting, and in this genial climate, where they are never injured by frosts or severe winters, they will bear from fifteen to twenty good crops worth from \$200 to \$300 per acre.

You are aware that in the eastern and northern States a peach orchard does not commence bearing before it is five years old and seldom bears more than two full crops during its life. This will explain to our friends why lands in California sell for higher prices than land in Illinois. The usual price for peach trees for setting is 15 cents each, though in large quantities they can be purchased for less money. Many successful fruit growers in this State provide for drying their own fruit, as by so doing they keep whatever profit there is in preparing the fruit for market and can also hold it until the price is satisfactory. This is an important matter to understand when planting an orchard, so that one can purchase the best varieties of trees. For instance, if a man is going to plant a peach orchard and intends to dry the fruit himself, he should purchase from four to six varieties of peach trees which ripen at different times, say a week or ten days apart. The first saving in this will be found in the fact that he will need to invest only about one-fourth of the

money in trays or boxes as he would if the fruit should all ripen at one time. Then he will not need to employ more than one-fourth as many hands to help care for the fruit as if he only raised one variety, and can therefore hire hands at a more reasonable rate than as if he needed a large number of them for only a week or so

WHAT LAND WILL EARN.

I find that dried peaches vary in price from 5 to 15 cents a pound at the railroad stations, depending on the amount of fruit raised in the eastern States. You know that two good crops in succession there is not a common occurrence, so that when the crops in the East are light, or almost a total failure, as this year, the profits from growing fruit in California is enormous. Dried peaches at 10 cents per pound here will yield a profit to the grower varying from \$150 to \$200 per acre when the trees are five or six years old. From interviews with fruit growers who have farmed in Illinois I learn that they would sooner raise peaches here and sell them dried at 5 cents a pound than to raise corn in Illinois and feed to hogs at 5 cents a pound. The profits realized from growing prunes, apricots and many other products in the San Joaquin valley is about the same, so far as I have been able to learn, as those realized from peaches. Now I have endeavored to investigate quite thoroughly the value of lands in the various parts of California, and the profits derived therefrom, and I am now thoroughly convinced that Kern county offers the best inducements for our people that can be found in California, and I am pleased with almost the entire State. I shall remain here until the middle of January as I desire to attend the Mid Winter Fair before returning home, so if there is any further information you desire please address me at San Francisco, and I will endeavor to furnish the desired information.

With kindest regards to all, and hoping that we may spend next winter on our Kern county farms, I remain, very truly,

AL. J. MILLER.

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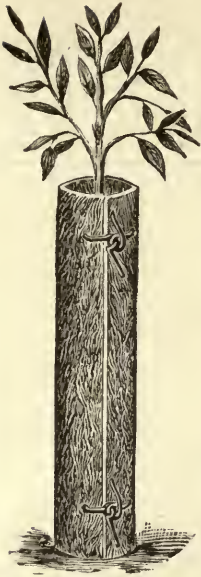
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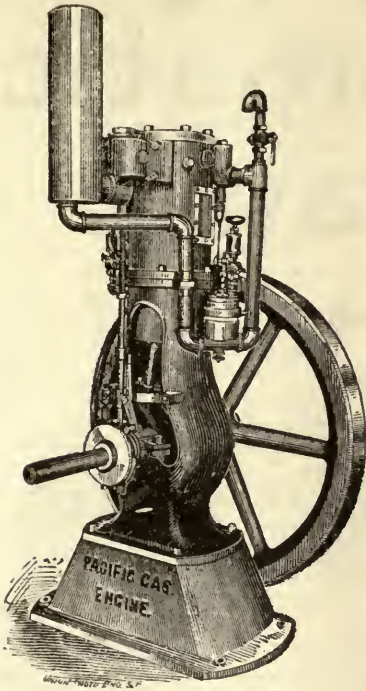
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PATENTED IN THE

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Makes all Sizes of Pipe from 4 to 30 inches.

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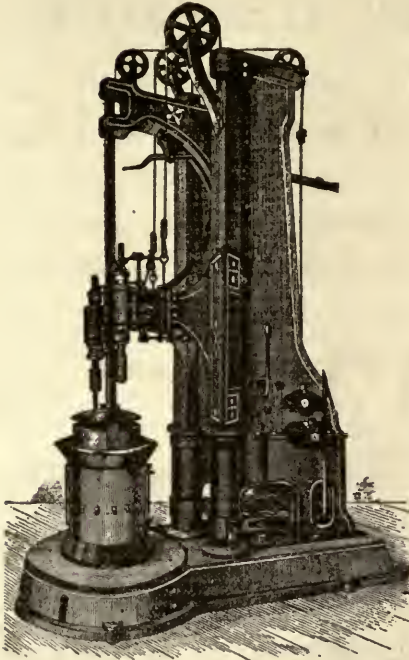
If you are putting in pipe for irrigation, you should keep in touch with all genuine economies as soon as their value is proven. You should do this to reduce the cost of irrigating your lands; it is important that you should consider every item that enters into the cost of putting your land on the market. Now this expensive item of pipe, can (with our machine) be so reduced that the labor need not be considered. Heretofore the principal item of cost in cement pipe was the labor. With our machine, the greatest cost is material, while the labor is an unimportant part.

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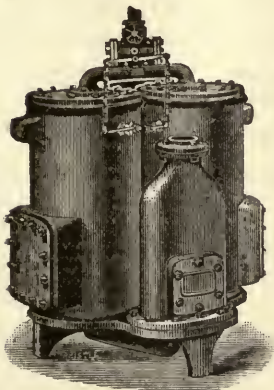
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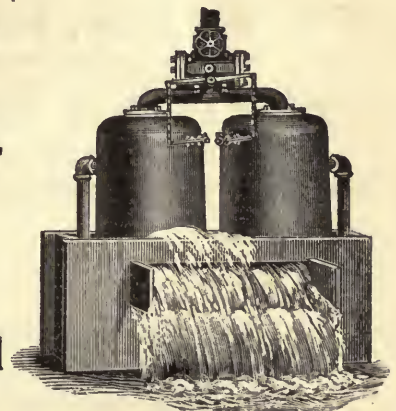
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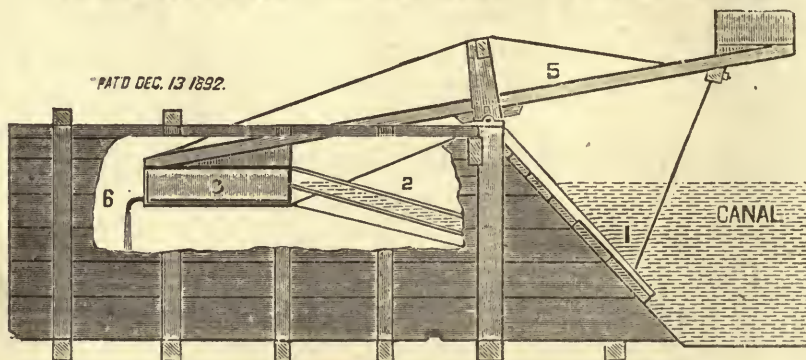
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THE IRRIGATION AGE.

VOL. VI.

CHICAGO, FEBRUARY, 1894.

No. 2.

THE PROGRESS OF WESTERN AMERICA.

A Test of Western Institutions. During 1894 western institutions will be put to new and severe tests. In a greater degree than usual they must rely upon themselves. The past decade was a period of generous investment. The undeveloped resources of the new country beckoned to the surplus wealth of the old countries and met with prodigal response. Money flowed readily into farm lands, cattle ventures, town lot speculations and mining and irrigation enterprises. It is not flowing readily to-day, nor can it be expected to seek the old channels with anything like the old enthusiasm in a long time to come. THE AGE foresees no calamity in this situation, but predicts, on the contrary, a more substantial and enduring prosperity as a result of the readjustment of conditions. The glittering symbol of the past period was Speculation. The deeply-carven motto of the new period will be Industrialism. The difference between these two forms of development is very wide and very deep. Speculation is the offspring of good times, and new countries with valuable but raw resources, furnish its natural breeding ground. Speculation may rest either upon a real or imaginary basis. Its rise and fall are regulated only by the flow and ebb of investment. Its pulse is always feverish, never normal and healthy. It is a thing apart from commerce, from manufactures, from agriculture, from mining. It is a shadow, not a substance. It is the creation of the mind acting independently, not the child of brain and hand working together, the one directing the other and both applied to the making of realities. Speculation leaves the country poor because it has produced nothing that did not exist before. It has merely taken from one man's, or many men's pockets and put into another. There is no more money than there was before, only a new distribution and generally upon an uneven basis. This is the lesson of the phenomena of speculation as it has been observed in all times and countries. It is the same in America, in Australia and in Argentina.

Two Modern Instances. The truth of these generalizations seems so palpable to those who know the West as to need no illustration, but it may be well to enforce them by reference to typical instances for the benefit of the class of readers who receive THE AGE in eastern cities and foreign countries. Let us take, to illustrate, two new towns in the arid regions of the West, equal in point of location, of railroad facilities, of tributary country, of surrounding mineral resources, of climatic conditions. Let us name one of these embryo cities Town Lots and the other Mid-Colonies. Town Lots falls into the hands of a skillful real estate syndicate. They distribute advertising matter far and wide, filled with glowing descriptions of the great natural advantages of this "city of destiny." They plan free excursions, lay out "acreage" into twenty-five foot lot additions, erect a few business blocks, subsidize one or two starveling industries. People crowd the local hotels and real estate changes hands with gratifying rapidity. Land prices advance and money is made and generally invested in more real estate, or in options. Town Lots is a booming city. The spirit of speculation is in the air. Everybody catches it. An easier way to make money than by labor has been discovered. But, after all, what has been added to the wealth of the community by the process of building Town Lots on the virgin soil of the valley? Absolutely nothing. There have simply been gathered together a body of consumers. Collapse and decay are inevitable. In the meantime, Mid-Colonies has pursued another plan. Under the guidance of wiser heads it has adopted an industrial policy. It has sought to attract no man who could not produce a little more than he consumed and no dollar which could not earn a fair rate of interest for its owner. It has discountenanced speculation as it would quarantine a person suspected of having a contagious disease. It has turned the rivers and reservoired the flood waters. It has laid out small farms and colonized them with

industrious families. It has found capital to develop the mineral resources, and it has left the town to build up as new stores and new dwellings are needed, allowing the price of real estate to take care of itself. It has recognized the scriptural injunction, "In the sweat of thy face shalt thou eat bread." Thus it happens that in these trying times when Town Lots is a graveyard of buried hopes, Mid-Colonies is a self-sustaining and comfortable community. Both aimed to attract population and capital, one by



W. H. HOLABIRD,
Of Claremont, Cal.

speculation and the other by industrialism. And each worked out to a logical end.

The Same in all Directions. This example would not be adequate without the explanation that the same principles have been applied to all the resources of the West. Speculation has neither begun nor ended with town lots. It has been the ruling spirit in the settlement of lands, in the building of railroads, in the exploiting of mining, cattle and irrigation enterprises. The scramble on the Cherokee strip was the final dramatic chapter in the story. The panic of 1893 has ended it, as it ended hundreds of speculations in the East, weeded out weak banks and shaky business houses and squeezed the water out of millions of spongy stocks. Hereafter, alike in America and in Australia, in the Western and in the Eastern States, values become the test of investments, and men will ask not, "What will it sell

for?" but "What will it earn?" And this brings us to the question of how the institutions of the West will stand the supreme test to which everything will be put during the next few years.

Where Prosperity Will be Rebuilt. What are the conditions which the business world faces to-day? Hundreds of thousands of honest workingmen are in total or partial idleness, not only in our country, but in England and Continental Europe. There is a glut of money in the banks as the simple and sure result of the withdrawal of money from all the channels of industry and trade. The products of the farm, except in a few communities where local conditions are peculiarly favorable, command only the poorest prices. Stagnation, absence of confidence, discouragement, apprehension for the future—these are everywhere, at home and abroad, the prevailing sentiments. While established enterprises languish, it is not strange that new ones in process of evolution move with slow step or pause altogether. And yet the world will not cease to revolve. Idle men and idle capital will find employment, because that is the condition of existence. But where will they find employment? Manifestly in those places where the application of labor and capital will create new values, yielding sufficient income to support the labor and pay a reasonable dividend upon the capital. Are these places to be found in the older States of the East? No; because those are manufacturing communities and there is nothing to invite the use of new capital or new labor there, even if these industries should enjoy a partial revival at an early date. The same is true of the middle West and the older portions of the South. The field is occupied with men and interests that must live. If the capital and labor already located there can support themselves they will do well. They cannot hope to attract recruits to any considerable degree at such a time as this. What, then, is left as the field for the remunerative employment of labor and capital—that remunerative employment that is bound to come, because it simply must come as the alternative of social and economic derangements that would involve the wreck of existing institutions? The field, and the only field, where surplus labor and idle capital can rebuild the national prosperity is in the greater West between the Missouri river and the Pacific ocean.

Utah a Beacon Light.

Every dog has his day—every country its opportunity. The day of fate is at hand for the Greater West. If it shall prove to be the outlet for surplus people and capital at this critical time in our national history, then its development along conservative lines will soon begin, and the movement must prove enduring. What are its capacities for meeting this supreme test? The

foundation industry of man is agriculture, using the term in its broadest sense. The Greater West will furnish the most marvelous field for the various forms of diversified agriculture that has ever been opened to enterprise. Major Powell, who will be accepted as very conservative authority, asserts elsewhere in this number of *THE AGE* that the arid regions will support a population as great as the present total of the entire United States. There is not space in this department to prove by elaborate argument that the agriculture of Arid America is peculiar in its promise of almost absolute independence, when considered in connection with the home markets with which it is everywhere surrounded. But the proposition may be proven in a dozen lines by reference to a single example, the truth of which is beyond dispute. Utah presents a fair average of the conditions existing in the arid West. In altitude and climate it is the mean between extremes. Less than fifty years ago it was colonized by a people who had no assets except the brain of a masterful leader of men. Under the guidance of this leader a certain industrial policy was applied. The farm unit was fixed at twenty acres. Each family was taught to produce first of all what it consumed, and second, a surplus convertible into some other form of property. This was accomplished by diversified production and intensive scientific cultivation. Upon the public range adjoining the cultivated valleys flocks of sheep and herds of cattle and horses were sustained. This experiment in colonization was carried to success without original capital. The people lived; they multiplied and prospered; they wrung from unpromising soil the capital for coöperative stores, for factories, for banks. And after paying for all this, they had an ample surplus to carry on costly church enterprises, building massive temples and sending their missionaries to the uttermost parts of the earth. Are the valleys hidden among the mountains of Utah any more productive than the irrigable lands of Washington, Oregon, Idaho and Montana on the north, Colorado and Wyoming on the east, New Mexico, Arizona, California and Nevada on the south and west? Are the unprosperous millions of the old world and old States less capable of conquest over nature than the simple folk who compose the mass of the Mormon people? Is capital distrustful of its ability to find security and create values in conjunction with enlightened labor in a field where labor unaided by capital has alone created enormous values?

Other Lines of Industry. Agriculture is not the only resource which the West holds out to revive the stricken prosperity of the times, but agriculture must be the basis of the first great impulse of settlement. Population secured, the growth of manufactures will be as phenomenal there in the future as it has been in the East during the past two



E. S. NETTLETON,

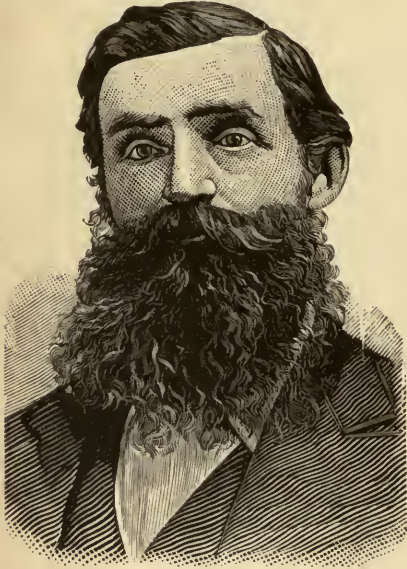
Chief Engineer of the Yaqui Irrigation Co. of Mexico.

generations. Manufactures never precede agriculture. They never flourish until the food supply is established, but in the West there are all the raw materials of manufacture and their use will be facilitated by the universal presence of water power and the rapid strides now making in the application of electricity. Mining will ever be a prolific source of wealth, but the wealth so obtained has generally gone quickly to remote metropolitan centers. Mining took over a billion of money from Nevada and left little but tin cans in exchange. The mining camp is a good home market, and as such will have an important part in the development of the country. Every single State and Territory is now increasing its gold output, and gradually the development of other mineral resources is supplying the place of the silver industry. In all these lines of activity success will turn on the policy of industrialism. Speculation is eliminated. Western institutions will stand the test of the new principle as readily as it will repudiate any attempt to revive the operation of the old. Let any fair-minded man compare the natural endowments of western States with those of the East and he will have a sudden and startling revelation of future events.

**Causes of
Irrigation
Failures.**

Some important irrigation enterprises have gone down in the general crash of recent times. These failures require explanation and furnish the text for observations that may well be made in the interest of the industry. No irrigation enterprise having sufficient merit to sell its securities in the market has any business to fail. Securities are not sold as a rule, and at least never

come several splendid enterprises that were simply mismanaged, either by means of wasteful construction, or by the issue of more securities than the plant could earn interest upon. In the case of the dry ditch referred to there is, of course, no escape from loss, but in most of the others, even where the failure was due to dishonesty, the enterprises will work out to success with careful management hereafter.



DR. N. G. BLALOCK,

Member of National Committee for Washington.

should be bought, until the project has been rigidly inspected by trustworthy men who can pass upon the water supply, the quality of lands, the nature of the engineering scheme and the ability and character of the individuals to whose management the undertaking is committed. No irrigation enterprise that responds satisfactorily to these tests ought to fail to meet reasonable expectations. The difficulty is that it is not generally understood precisely what the term "responds satisfactorily" means. Before discussing that phase of the matter it is well to say that there have been a few failures that may be attributed to downright dishonesty and a few more that must be credited to blundering incapacity. In one instance a very large issue of bonds was sold upon a basis of \$2 in bonds for \$1 in cost. In that case so much money was made out of the bonds that little incentive remained to induce the parties responsible to develop the enterprise on its industrial side. In another case a dry ditch, for which there can never be an adequate water supply, was foisted upon foreign bondholders at high figures. Both of these were instances of deliberate dishonesty. Under the head of blundering inca-

But there are instances where enterprises managed by honest men, and bonded on a conservative basis, have found themselves in difficulties during the past few months. - It is this class of failures which it seems difficult to explain, and yet those who are familiar with the irrigation industry from the inside are at no loss to understand them. The unsolved problem is successful colonization. The assets of an irrigation company consist of water rights and land. These assets possess only prospective value. They require to be developed and the missing link is generally the colonist. Money is not made when the water is diverted from the river, when canals are constructed and the ditch brought to the head of the field. That is only the foundation of success. The point is now reached where the presence of the colonist becomes a necessity. And it is the failure to attract settlers, and thus to convert the company's assets into money, that accounts for the disappointments which have been encountered in connection with companies whose plans are intrinsically good and whose managers are perfectly reliable. In the end there can be no fear for the outcome of these enterprises. The settlement of the future must necessarily be on irrigated lands. The time will come when every acre of land now under irrigation, or to be brought under irrigation hereafter, will be in demand. But if quick results are desired a way must be found to provide a constant stream of colonists to occupy the lands.

**The Need
of
Trained
Men.**

There is still another reason why the industry has not been as prosperous as it will some time become. This is the fact that there have not been developed a class of trained irrigation managers. When a great railroad system has a presidency to fill it chooses its man from the ranks of those who have been trained to the business. It chooses men for their special fitness, pays them handsomely, and, as a natural consequence, receives the best that talent, training and industry have to give. It is seldom that men corresponding in their business to first-class railroad executives in theirs find their way to the head of great irrigation companies. One reason is that there has not been time to develop a class of irrigation managers. But another reason is that the men who have discovered an opportunity for an attractive project,

or who are able to float securities, put themselves at the head of such enterprises. The ideal irrigation president should be a well-rounded man of practical experience, possessing a good degree of knowledge about all the departments of the business. He need not necessarily be an engineer, but he ought to have a good comprehension of what is required in that department. He need not be a practical irrigator, but he should understand something about the soil with which he is dealing, the crops and markets, and the methods of irrigation and cultivation. He need not be an accomplished promoter, but he ought to be capable of meeting his stockholders or bondholders on terms of equality. In short, their irrigation president should be a man of first-class parts, possessing a good general knowledge of all the factors that enter into his business, from the time when the first survey is made for a new canal to the time when the colonist builds his home on the land under that line. There is no more attractive opening in this country to-day than what we may call for want of a better term, irrigation administration. There is a

crying need for men who will make a study of every phase of the business from the stand-point of the responsible administrator. Such men will surely be evolved in time, but may we not hope that the pro-

cess of evolution can be stimulated? The subject is certainly worthy of the attention of bright young men who are disposed to make a place for themselves in the domain of large affairs.



ROCK CUT ON THE LINE OF THE BEAR RIVER SYSTEM IN UTAH.



L. J. CARPENTER,

Member of the Colorado Irrigation Commission.

**Good
Timber
on Hand.**

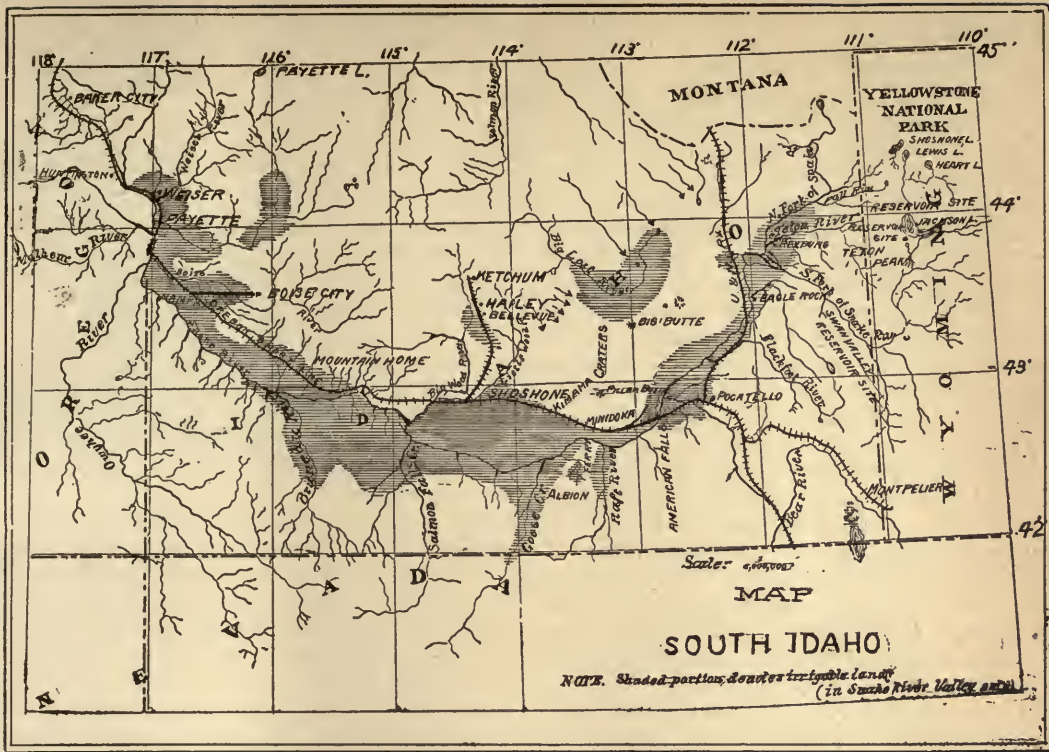
It would be unfair to leave the subject without remarking that Arid America is already full of good timber for irrigation managers. Among the strong men now well to the front, some of them with very substantial achievements behind them, are Chas. W. Greene, of the Pecos valley in New Mexico; S. W. Fergusson, of the Kern County Land Company in California; William H. Rowe, of the Bear River system in Utah; T. B. Sweet, of Topeka, who is guiding large enterprises in Colorado, Nebraska, Utah and Montana; Matthew Gage and Frank E. Brown, of the Riverside and Redlands localities, respectively; W. E. Alexander, of the Denver Water Storage Company; W. S. McMullan, of the Toltec system in Southern Colorado; W. J. Murphy, of Arizona, Paul Schultze, of Washington, C. W. Aldrich, of Utah, and several others. In this list are men of large ability, but in most cases they have developed special branches of the business rather than devoted themselves to the subject as a whole. The necessities of their business are rapidly maturing them into the well-rounded and thoroughly equipped class of men who may be expected to render the highest service to irrigation.

**Promising
Colony
Plans.**

More attention is now being paid to this branch of the industry than ever before. Very attractive plans are under way in many localities. And other plans, more interesting and daring than any yet undertaken, seem likely to be laid before the public in the course of the next few weeks. In another department of *THE AGE* the progress of colonization receives due attention. The California irrigation companies are particularly aggressive at this time, and appear to be meeting with a very fair degree of success. It is now apparent that California advertised herself quite effectively at the World's Fair. Idaho and Washington are also receiving considerable benefit from the same cause. In our view the times, which are now so unfavorable for general business, furnish substantial encouragement for the promoters of colonization. Vast numbers of people are out of work. Many of them have means and many of those who are poor contain good material for citizenship. The sharp and general depression has revealed with fearful distinctness the eternal fact that no man is independent who depends on others for employment. Only those who live upon their own

land, and dwell beneath their own roof are in the best sense independent. The vigorous presentation of attractive colonies ought to meet with generous reward at this time. This idea should sink deep into the minds of all managers of irrigation projects. The results of the year's work will be simply astounding if enlightened efforts are made in this direction.

There have been failures enough among **State Supervision** irrigation companies this year to **A Necessity**. teach the western people the necessity of providing laws which shall protect investors against the promoters of wild-cat projects. The Los Angeles platform demanded that the new code of State laws which it is proposed to devise shall insist upon the rigid supervision of irrigation companies. The States of the arid region are fighting hard to obtain the confidence of investors and settlers. They should take measures to make it as difficult as possible for unworthy or reckless men to injure the good name of their community. Let a prominent company fail in California, entailing a large loss among numbers of investors in the East or abroad, and every interest in Southern California which seeks to attract capital or



THE SCENE OF ACTIVE COLONIZATION ENTERPRISES.

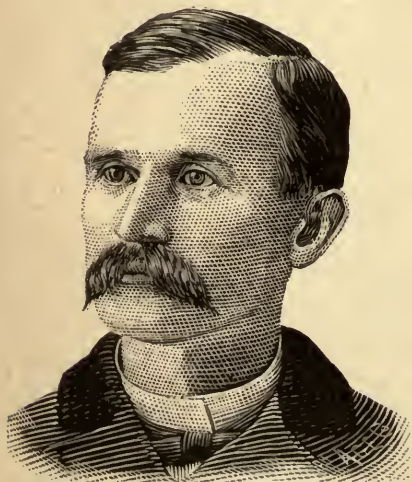
population will find that a stupendous obstacle has been placed in its way. The same statement applies to all other States and Territories. Every irrigation project should submit its plans to a department of the State government before placing its securities on the market. The State would thus lend its moral influence to any project which obtained its approval. It is perfectly feasible for the State to pass intelligently upon the water supply, character of lands and amount of security involved in an irrigation proposition. It may even go further with safety and undertake to vouch for the character of the men behind the enterprise. With such a certificate the sale of good securities would be rendered easier, and without it it would be very difficult indeed for a project to succeed. The time has come when every doubtful scheme should be plainly illuminated. THE AGE stands ready to investigate anything of this nature which may be brought to its attention in good faith.

Fruit Growers Must Combine. A leading article in this number of THE AGE describes the efforts which are being put forth by the fruit growers to break the monopoly of the commission men. The subject is one of the utmost importance. It appeals not alone

to those engaged in the fruit industry of California, but is equally interesting to Arizona, New Mexico, Colorado, Idaho and Washington, and whatever other localities are seriously attempting to build up a profitable trade in this line. In California the commission men have the producers by the throat. The methods which have succeeded in bringing about this result there will in time be applied with equal success everywhere else. When the commission house advances money upon the crop and obtains a contract to dispose of the product on such terms as it may deem best, the grower is on the road to financial ruin. This process has resulted in depressing the price of fruit on the western ranches to a ridiculous degree, but the eastern consumer does not get the benefit of the reduction. He pays as much as in the days when the fruit-grower enjoyed his greatest prosperity. The only remedy is coöperation. This furnishes the means by which growers, by their united credit, can secure such advances as they may need and then dispense with the middlemen in placing their goods on the market. It is very important that the present movement in this direction should succeed. Every effort should be made to strengthen it.

Maj. J. W. Powell's article on "The Water Supply of the Arid Region", the first installment of which appears in this number of THE AGE, has been awaited with widespread interest. It is the logical sequel of his celebrated speech at Los Angeles. While there appeared to be but one opinion in the Irrigation Congress on the merits of his remarks, THE AGE has been receiving evidence ever since of a very general desire to have the subject thoroughly and fairly discussed. Letters from all parts of the United States, and, indeed, from beyond the borders of our own country, have informed us that many people who are deeply interested in irrigation were unwilling to let the matter rest as it was left with the report of the Congress. While Maj. Powell's statements were everywhere conceded to have been put in a startling manner, it is evident that unprejudiced people feel that there should be some attempt to account for the discrepancy between the statement of the Director of the Geological Survey and the assertion of representative men who took issue with him. THE AGE found that Maj. Powell was perfectly willing to prepare for these pages a careful and elaborate statement of his views on the water supplies of the arid region and the relative amounts of land in private and public ownership still open to irrigation. In this number he deals with one department of his subject—the extent, character and source of the water supply. The series of papers will be continued in March and concluded in April.

A Vital Point Conceded. The first contribution will be studied with the utmost interest and will secure a careful reading for the other two. The reader will observe that the Director begins his discussion of the water supply at the beginning, and



J. W. GREGORY,
Chairman of the Kansas Irrigation Commission.

proceeds to lay a scientific foundation for ultimate conclusions. He puts his statement of the duty of water in a very attractive and convincing manner. What is said about the annual precipitation, and the disposition which nature makes of it,

is clearly illustrated, both by map and text, and the most jealous friends of the arid region will find little ground to take issue with him here. The most important statement in the article is to the effect that the arid region will sustain as



W. A. CLARK,
Member of Montana Irrigation Commission.

large a population as the present total of inhabitants in the United States. This is a broad admission and puts the Director quite on a plane with the men of the West who claim that they will open a field where millions of men will make their homes, and where better forms of civilization than the world has yet seen will be developed during the next century. If this is the conclusion reached, no matter by what train of logic, there can be no quarrel between the conservative view represented by Maj. Powell and those who are fighting for the irrigation idea in its broad aspect. There is no doubt that when Maj. Powell enters upon the discussion of particular localities he will find serious grounds for disagreement with some friends of the cause in the West. This, however, can not obliterate the great fact that it is admitted that Arid America is a field of imperial dimensions, wherein the champions of a new civilization will have ample room to apply their theories, confident that if they prove practicable they will lead to wonderful results.

Let Us Be Fair.

THE AGE asks for the papers of Major Powell the most careful and patient study. It is well at a time like this, when the conditions of enterprise are in process of readjustment, to consider our possibilities from the most conservative basis. The confidence of capital can best be won by a policy of frankness and toleration which shall invite the closest study of our water resources and irrigable area. The news went far and wide last October that Major Powell had flatly contradicted the fundamental assertions on which the men of the Irrigation Congress had built their hopes of a great development. Let us now learn to what

extent this was true. Early in November THE AGE invited several prominent engineers to discuss the water supply of certain States and Territories with relation to the public lands. The articles written in response to this request were submitted to Major Powell for the purpose of ascertaining to what extent he disagreed with their conclusions. These articles will be published in due time. We believe that when the matter has been discussed calmly and thoroughly, men who have seemed to be wide apart will find themselves in substantial agreement upon all important propositions. This is the result which THE AGE sincerely desires to bring about. These pages will be open to the discussion of Major Powell's conclusions at the proper time. The public is well aware that THE AGE is emphatically with the optimistic wing of the irrigation public. If we can afford to listen to the voice of conservatism, so can every one of our readers. We begin the publication of Major Powell's very able and exhaustive papers in the complete confidence that they will contribute very largely to a good understanding among men whose differences have been a menace to the cause, and that the result must be of great and lasting benefit to the irrigation industry.

**Nebraska
Meeting
A Success.**

The irrigation revival in the semi-arid region continues to gather strength and seems likely to accomplish substantial results during the present year. The December convention at North Platte, Neb., to which reference was briefly made in the last number of THE AGE, was a very successful event. The attendance was large, and the interest intensified steadily until it became genuine enthusiasm at the end. Very properly, attention was largely devoted to the possibilities of irrigation by pumping. The surface streams of Nebraska are not numerous, and are already largely utilized, but there are still good possibilities of reclamation by the use of pumps and windmills. When the fullest advantage is taken of these, western Nebraska will exhibit a very interesting phase of the irrigation industry. There will be at least ten acres intensively cultivated on each farm, while the balance of the quarter-section will produce good, fair or poor crops, according to the caprices of the weather. There will be years of plenty, but no years of utter discouragement, because the ten acres will support the family. President I. A. Fort deserves great credit for the work he has done in arousing the people of the semi-arid region. The Interstate Irrigation Association will have a grand convention at Omaha in March, and on that occasion the hosts will rally from Kansas, Nebraska and the Dakotas, and send out an influence that ought to bear splendid fruit in the course of the next few months. This region is already settled, and the need of irrigation is therefore the more pressing

**A Type
of Western
Yankee.**

W. H. Holabird, whose picture appears elsewhere in this department, is a type of the Yankee—Western men who have grown up in the great West. Save during the Rebellion, Mr. Holabird has lived in the West since his early boyhood, residing some ten years in Chicago, and the remainder, about twenty-five years, in Arid America. Dealing in lands, he has seen the evolution of Kansas, Colorado, and finally dropped into California in time to be one of the chief factors in promoting the great land dealings in 1886-88. Subdividing all the railroad holdings for the Atchison system, he has learned Southern California as a boy knows his father's pastures. He then spent three years examining the State of California and making voluminous reports of all the great industries and possible routes for railroads through the mountains and valleys, for Allen Manvel, late president of the A. T. & S. F. R. R., and it is not extravagant to say that no man in California is better informed concerning the great possibilities of California than Mr. Holabird. He is sometimes called the "Encyclopedia of the coast." Mr. Holabird has an extensive acquaintance and retains his friends.

A thorough horticulturist, he is practically acquainted with all features of farming and the use of water as the greatest factor God has given in promoting human happiness. His home in Claremont, Cal., is his own creation, and is an ideal of what we call a beautiful rural home, and is truly in his case, "the throne of human felicity." Mr. Holabird's illustrated lectures on irrigation in California attracted much attention early in the winter.

**The
Wright
Law.**

THE AGE receives occasional complaints from California concerning the workings of the Wright Law. Various causes of dissatisfaction are alleged, and THE AGE is criticised for its friendly attitude toward a measure which these critics regard as the fruitful source of discord and promise of future loss. The fitting reply to such criticisms may be summed up in these statements: Wherever the Wright Law has failed to meet the expectations of its friends the disappointment was due to one of two causes: (1) The officers to whom the affairs of the district were committed were incompetent or dishonest, or (2) the district was located in unsettled territory and applied to uses for which the law was never designed by its friends. Neither of these fatal errors are chargeable to the law itself. No abstract provision of law can make men honest or competent, and when they are otherwise any law is liable to have evil effects. When a district is located in advance of settlers, as has happened in some instances, it becomes an anomaly and farce. No such burlesque on the Wright Law should be again permitted.

THE WATER SUPPLIES IN THE ARID REGION.

FIRST PAPER: "THE DUTY OF WATER AND THE SOURCES OF SUPPLY."

BY J. W. POWELL, DIRECTOR OF THE U. S. GEOLOGICAL SURVEY.

IN the western half of the United States agriculture is in part dependent upon irrigation, or the artificial supply of water. The extent to which such agriculture can be carried on depends, first, upon the amount of water which a growing crop requires, and, second, upon the amount of water which can be artificially supplied. In considering these questions it is necessary to use some unit for the measurement of water, and for this purpose one which is simple and practical is readily found. Land is usually cultivated by acres, and water can be measured in terms of acres. An acre of water one inch deep may be known as an *acre-inch*, and an acre of water one foot deep may be known as an *acre-foot*. The first problem to be solved is this: How many acre-inches of water are necessary for the adequate supply of an acre of growing crop for one year? There are two methods by which this can be determined, and it is found that substantially the same conclusion is reached by either method.

I.—THE AMOUNT OF WATER REQUIRED.

1. For more than a century scientific men have been engaged in determining the amount of water which various plants will consume through their roots and exhale through their leaves, the process being known as transpiration. This investigation has been pursued by various methods and by different men, and a common general result has been obtained. It has been found that different kinds of plants require varying amounts of water. Deciduous trees require more than coniferous trees with needle-shaped leaves. In general, grasses, vegetables, cereals, and fruits require a relatively large amount of water, as will be seen by the following statements.

Grass growing in turf will transpire in one day a weight of water a little greater than the weight of the dried grass.

Many vegetables will exhale in one day an amount of water as great or greater in weight than the dried plants.

Cereals, such as wheat, oats, barley and corn, will exhale their dry weight in water every day.

Perennial vines and trees that bear fruit, such as the grape and the apple, will exhale every day a

weight of water equaling the weight of the dry growth of the year.

Assembling these facts, the following general statement can be made: All average cultivated plants will daily exhale an amount of water equal to the dry growth of the plant for the year. This growth is effected in varying times with different plants. Some plants continue their growth for 75 days, others for 150, or even longer; but in general the plant requires for good growth water amounting to about one hundred times the weight of its yearly growth when dried. Thus a ton of hay requires 100 tons of water for its growth. The hay is not perfectly dry, but the loss by complete drying about equals the weight of the dry stubble and roots. An acre-inch of water weighs 226,600 pounds, or about $11\frac{1}{2}$ short tons. Two tons of hay require 200 tons of water, which is about 13 acre-inches. If the crop of hay on an acre is two tons the acre of grass will transpire 18 acre-inches of water.

THE DUTY OF WATER.

We thus turn proportions into measured quantities by acres of crop and acre-inches of water, and we have a statement of the acre-inches of water which it is necessary to supply to an acre of growing crops for one year, which may be called the *duty of water*. This duty of water, then, as here defined, is the amount of water in acre-inches which will be required by an acre of growing crop for one year. In stating this duty of water it will be given for an average growth, not for the maximum growth, as will afterward be explained.

WHEN THERE IS VARIATION.

There are variables to be considered in this problem; that is, the duty of water will depend upon latitude, altitude, humidity of the air with clearness of sky and kind of crop. In northern latitudes plants need less water than in southern; in higher altitudes plants need less water than in lower; in more humid conditions of the air plants exhale less water than in arid conditions, though there seem to be some curious exceptions to this; and, finally, some plants require more water than others. But these variations are not so great but that they may be safely neglected for the general statements herein proposed, and it may be stated that an acre of aver-

age growing crop will require a mean supply of water of 18 acre-inches. This will be called the absolute duty of water.

ABSOLUTE AND POSSIBLE DUTY.

When water is applied to the land by pipes and all possible precautions against evaporation are taken—the ground well prepared and the water applied in such a manner that there is no loss by overflow, no loss by seepage, and a minimum loss by evaporation either by reason of mulching or shallow surface cultivation, at least 2 acre-inches of water will be lost by evaporation from the soil. We have, then, the absolute duty of water as 18 acre-inches and the possible duty of water as 20 acre-inches.

THE PRACTICAL DUTY.

For average crops, all water given to the land in excess of this amount evaporates from the surface of the land or runs away over the surface and underground, and is therefore wasted. But all such waste of water cannot be avoided except at an impracticable cost. In putting the water on the land some amount must necessarily be evaporated. Under good conditions of cultivation, therefore, it is believed that 6 acre-inches of water must be added to the 18 inches; so that, in the western half of the United States, the mean absolute duty of water, plus the practically unavoidable evaporation, is 24 acre-inches for every average acre of crop. Otherwise stated, an acre of growing crop will drink up by its roots and exhale by its leaves an acre of water 18 inches deep during one season, and in applying this water under economic conditions an acre of water 6 inches deep must be wasted by evaporation. The absolute duty of water is 18 inches; the possible duty, 20 inches; the practical duty, 24 inches.

EXPERIENCE SUSTAINS SCIENTIFIC INDUCTION.

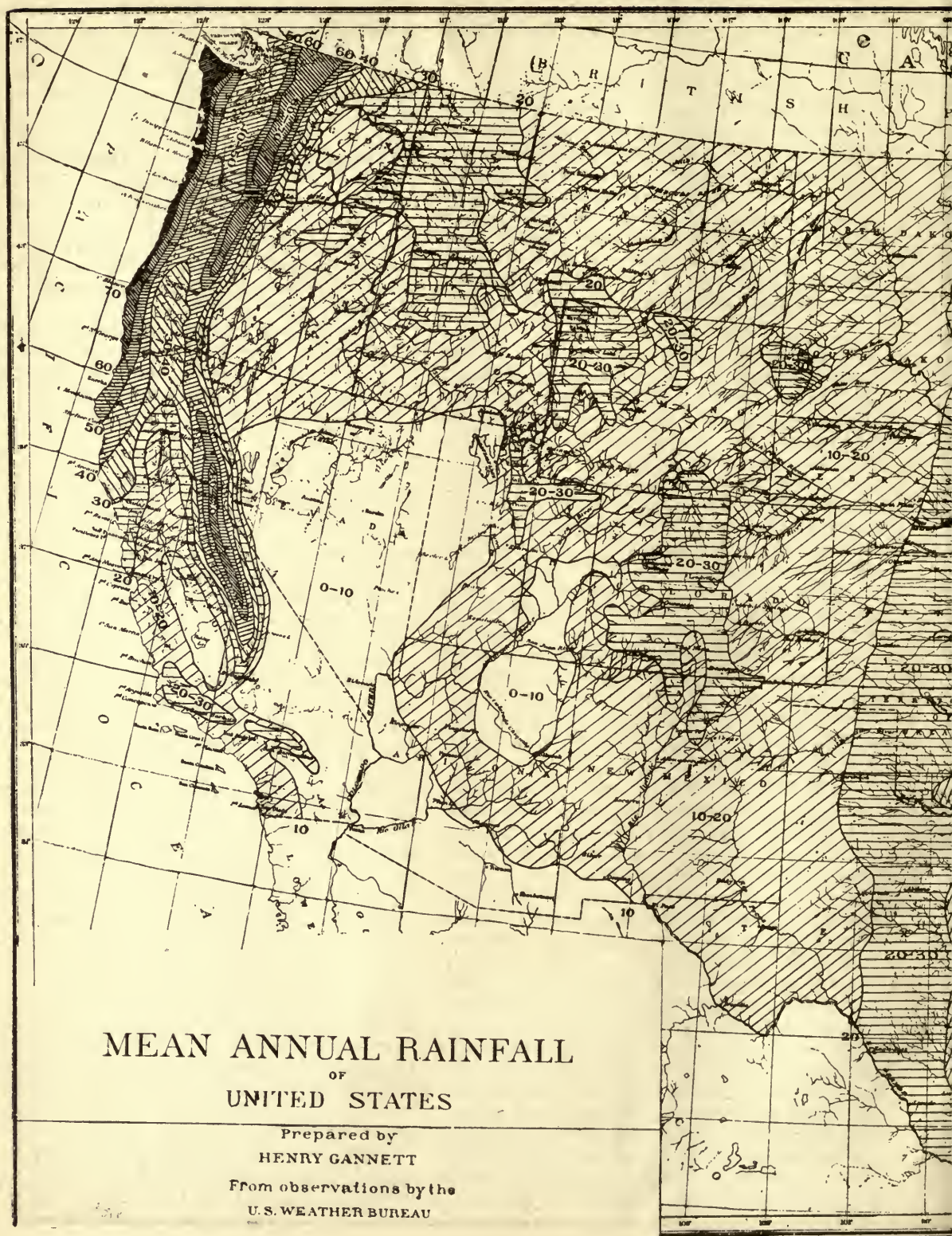
2. When the last census was taken it was found that an area of about four million acres of land was cultivated by irrigation in the western half of the United States. These lands were scattered widely over the whole region in small tracts; so that the experience of irrigators in this country is already extensive and highly diversified in relation to latitude, altitude, atmospheric humidity and crop. In taking the census many other facts were collected, and among these were the amounts of water actually supplied to the lands by the farmers themselves. It was generally found that the farmers are putting more water on the land than is really necessary, and that this extra amount is usually recognized by irrigators as excessive. The excess occurs in part through evaporation and in part by overflow onto other lands not irrigated, and still another part is lost underground by seepage. The general average in practice was found to be about 30 inches. It was further

found, however, that in a few places, where for economic considerations great care was demanded, the duty of water was actually brought down to nearly 20 inches. Thus the widely diversified experience of the farmer is a reasonably approximate confirmation of scientific induction. But this 20 acre-inches is sufficient only when the water is carried in watertight canals or in pipes, and the ground is thoroughly prepared for its reception, and the most advantageous methods of applying the water are used. Excluding the very exceptional cases, good practical irrigation requires 24 acre-inches of water. Any amount additional to 24 inches put upon the land is not only wasteful of water, but injurious to the crop, as will hereafter be shown.

The conclusion is thus reached that the mean absolute duty of water for the arid region of the United States is 18 inches, the mean possible duty 20 inches, and the mean practical duty 24 inches; and all water put upon the land in excess of 24 inches is an injurious duty.

IMPORTANT QUALIFICATIONS.

With regard to the duty of water, as heretofore set forth, some very interesting and important qualifications should be made. The quantity of water which has been given as necessary for growing crops is for average crops, not for maximum crops. It has been found by numerous experiments that the growth of most crops can be greatly increased by providing conditions for the utilization of a greater amount of water. If the soil is underdrained and properly prepared and the water supplied with the proper fertilizers, a much larger production can be realized than that which our farming usually secures. The water supplied to the plant is the vehicle of the materials wrought into the plant. Those who have studied this subject with great care state that the crop can be doubled, or even multiplied five-fold, by properly supplying it with water and plant food. But under these circumstances water supply must be increased proportionately. Suppose the farmer could control all the conditions, as the gardener can in his hothouse covered with glass; then 150 or more bushels of wheat, barley or corn could be raised on an acre of land. But 60 to 100 inches or more of water would be necessary. Again, it is found that in order to secure the maximum growth of plants certain careful conditions of supply must be observed. Some plants will grow in water; a few cultivated plants will grow in marshes; but dry land crops will be injured by an excess of water. To such plants water must be supplied in minutely divided quantities and thoroughly aired. Soil will often contain 30 per cent. or more of its weight if completely saturated, but in this condition dry-land plants do not flourish. It is found that about 60 per cent. of satu-





ration gives the best results for dry-land plants. This is the reason why over-irrigation is injurious.

Again, it is found by experiment that the growth of the plant will be checked by checking the water supply, which must be continuous to the most successful; that if checked the plant adapts itself to the new conditions, and if afterward the normal supply is given, the plant will not avail itself of the better condition. It is also found that if the plant is urged to its greatest capacity by the best conditions during the early part of its growth and until the grain or fruit has nearly attained its full size and the water supply is then diminished, the yield will usually be increased and improved in quality; if the leaf growth is then checked the fruitage is increased.

II.—THE SOURCES OF WATER SUPPLY.

The preliminary question of the duty of water having been examined, it is proposed to indicate the source of water supply for the regions of the United States where irrigation is practiced. The rainfall of the arid region is variable, ranging from 3 to more than 20 acre-inches per acre of surface. The facts relating to the distribution of this unequal rainfall are graphically set forth in map No. 1, entitled "Mean Annual Rainfall of United States." On careful examination it will reveal all of the important facts as they have been generalized from the rain-gauge records of the United States. Both official and unofficial records have been used, so far as they have been discovered. It is to be carefully noted that the rainfall is variable not only from district to district, but also from year to year and month to month, and that the yearly and seasonal variations are very great.

PECULIAR CONDITIONS.

There are large districts in the arid region where, in extreme cases, not a drop of rain falls for an entire year, while in other years the very same regions experience terrific storms, and utterly arid deserts are suddenly transformed by the creation of storm-water streams, and rivers roll as floods, creeks as torrents and brooks as leaping waters. Scattered throughout the arid region are many mountains towering above the valleys and performing the beneficent function of condensing the waters from the heavens and gathering them into lakes as natural reservoirs for perennial streams. These mountain-gathered waters constitute the most important supply for the fertilization of the land. Throughout the arid region there are many comparatively large districts which have no perennial streams, and these districts increase in size from north to south, until districts as large as any one of a number of the eastern states are found without a single living stream. But all of these districts without permanent rivers and creeks

have storm-water streams that are sometimes of great volume. Throughout the arid region streams rise in the mountains and flow into valleys so arid that the waters are all consumed by the thirsty soil and evaporate into the wind-vexed air. Sometimes the sands do not drink up all of these waters, and salt lakes are formed, from whose noxious surfaces the waters are discharged by evaporation.

Having determined the mean rainfall of the arid region with a reasonable degree of accuracy, we have next to determine what becomes of the rain.

"RUNOFF" AND "FLYOFF."

When it falls upon the earth a part of the water is gathered into streams and is carried away into sinks, lakes and the ocean; let us call all this stream water *runoff*. Another part is carried away by the air and this air-borne portion is in part evaporated from the surface of the land and from the leaves of plants, while another part is delivered to the air by transpiration. All this air-gathered water is drifted away by the winds, and therefore let us call it *flyoff*. The rainfall, then, is divided between runoff and flyoff.

The Geological Survey has been engaged for several years in an investigation designed to determine the relative proportions of flyoff and runoff, in order to properly account for the disposition of the rainfall made by nature. It is proposed to give the general results of this investigation.

Knowing the rainfall, we must then determine the runoff, and this is done by gauging the streams. All the streams have not been gauged, but many have been, and these have been selected as typical cases.

AN ANALYSIS OF RUNOFF.

It has been found by observation that the runoff is variable in three ways. 1. It varies with the amount of rainfall. If the rainfall is greater the runoff is greater. 2. It also varies with the character of the rains. When the rains come in great storms a large proportion runs off. A gentle shower is found to be almost wholly evaporated. If a year's rainfall is concentrated into two or three great storms it will largely go into the streams, but if distributed through many showers it will be returned to the air. 3. Again, topographic conditions greatly influence the runoff. In a region of steep hills, mountains and cañons, with many naked rocks, the runoff is very great; in a level district, where loose sands and soils prevail, the runoff is small. Thus the rainfall becomes runoff in an unequal degree by reason of the inequality of storms and also by reason of the inequality of topographic features.

In gauging the rivers of the United States results have been reached as follows:

Where the rainfall is 40 inches the runoff will be 20 inches; one-half is runoff and one-half flyoff. Where

the rainfall is less the proportions are changed. With 30 inches of rainfall 18 inches will go to the air and only 12 inches to the stream, two-fifths runoff and three-fifths flyoff; but the amount will be variable in different districts, because of topographic conditions. With 20 inches of rain the amount of runoff will be 5 inches, one-fourth runoff and three-fourths flyoff; but the proportion will vary by reason of topographic conditions. Where the rainfall is 10 inches the runoff is a little less than 1 inch, one-tenth runoff and nine-tenths flyoff, but variable by reason of topographic features. As rainfall diminishes, topographic conditions have greater control. At 10 inches and below, topography almost wholly controls the runoff. Where the rainfall is the same the streams may be few and small or many and great. There are large tracts of country in Arizona, southern California and Nevada where 10 inches of rainfall never gives a permanent stream and rarely a storm stream. There are other districts of country where 10 inches of rainfall gives birth to many living waters. If the lands are comparatively level the sands drink all the water; if the lands are traversed by cañons carved by rivers that have their origin in the mountains, a labyrinth of lateral cañons is formed and the rainfall is promptly gathered into streams which roll into salt lakes or into the sea. The rain in the desert is gulped down by the sand; the rain in the cañon is gathered into a creek.

WHAT BECOMES OF THE RAINFALL.

We must now get a clear understanding of what is meant by runoff. Most of the streams of the United States ultimately discharge into the ocean; all of the water thus carried to the sea is runoff. Some of the streams of the arid region empty into salt lakes; all the water thus discharged is runoff. A very large number of small perennial streams of the arid region are discharged into what are usually called sinks; that is, into sand valleys, where their waters are evaporated; all this water is runoff. There is still a great multitude of small storm-water streams that live only a short time after a rain and whose waters are gathered into sand valleys and evaporated or into perennial streams; all such waters are runoff. Much rainfall sinks into the soil; a part slowly evaporates and becomes flyoff, but another part issues again as springs, and spring water is here considered as runoff. Rivers, creeks, brooks, storm-water streams and springs constitute this available water which we call runoff.

The water supply for irrigation in the arid region must mainly come from the runoff where the rainfall is 20 inches or less, for with some exceptions it is the runoff water which is used in irrigation. Crops are not raised throughout the entire season, but during a period varying in different portions of the country, and with different crops, from 60 to 150 days. If the

rainfall of the entire year would come during the growing season, with a fair distribution throughout the days, a large part of the arid lands could be cultivated without irrigation, but in fact the rainfall is unequally distributed throughout the year.

INEQUALITIES OF THE RAINFALL.

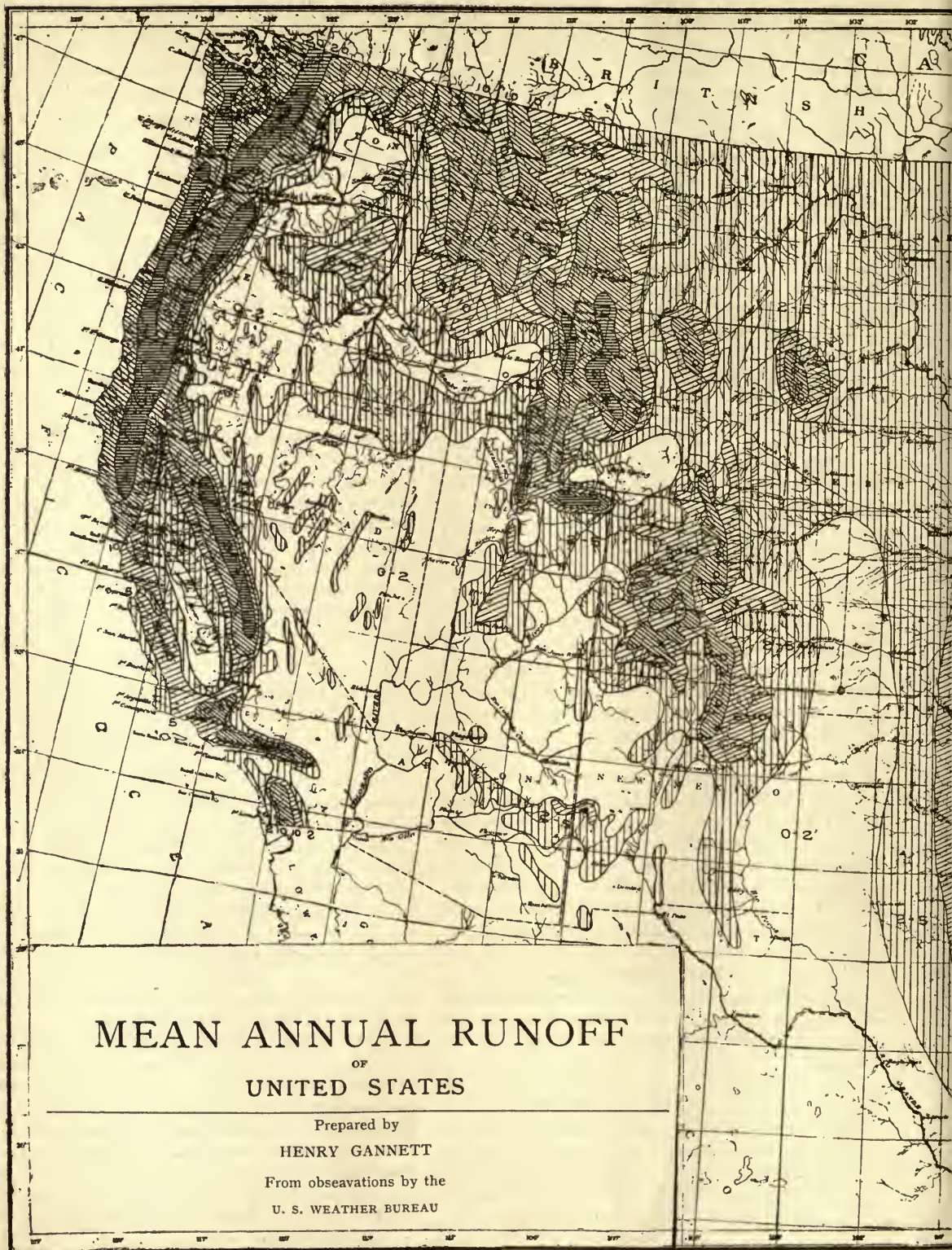
The inequalities of rainfall through the season are very great. Everywhere throughout the arid region it often occurs, now here and now there that no rainfall comes during the growing season; so that it is necessary for the farmer to provide by irrigation water for the entire crop. He may have rainfall and he may not. If therefore his agricultural operations are to be successful from year to year he must provide all the water necessary for the crop. The water which can be utilized for this purpose must come from the runoff, with exceptions hereafter to be mentioned.

We have given certain laws relating to runoff for definite amounts of rainfall of 40, 30, 20 and 10 inches. Now it is proposed to apply these laws to the arid region by district of country, and to show the average runoff by such districts; and for this purpose we shall consider runoff in zones or regions where the runoff varies from 20 to 30 inches, from 10 to 20 inches and from 0 to 10 inches. Of course, these zones everywhere run into one another; definite lines of boundary are not made in nature, and only approximate lines of boundary can be laid down.

THE MEANING OF THE MAPS.

It is not practicable to describe areas of country in words; the mind fails to properly conceive that which is told. But where speech fails map representation succeeds. For this reason a map of the United States is presented, exhibiting the several districts as above defined in comparison with other districts of the eastern portion of the United States where the runoff is greater. This map, entitled "Mean Annual Runoff," will help to make my statements clear and show to what districts of country they apply. It will be found especially instructive when compared with the rainfall map which precedes it. In the construction of the runoff map the laws heretofore explained have been used, and topographic features have received consideration. It will be seen that the runoff map does not wholly coincide with the rainfall map, from the fact that topographic features play a more important part in runoff. Altitude affects rainfall, and altitude and character of surface affect runoff; and as rainfall becomes less, runoff is affected by character of surface in a steadily increasing ratio.

Turning to the districts represented in the map, the following statements may be made: It has been seen that the practical duty of water is 24 inches. Now, where the runoff is from 5 to 10 inches, if all the run-



off were caught and used in irrigation, nearly one-third of the land could be irrigated, but in that region the rainfall itself is usually sufficient for agriculture, and irrigation is only needed as supplementary to the rainfall.

EFFECT OF TOPOGRAPHY.

Where the runoff is from 2 to 5 inches the total is about one-seventh of the amount necessary for irrigation; that is, a catchment of seven acres, if all is utilized, will irrigate one acre. Where the runoff is from 0 to 2 inches, some interesting conditions are found, which must be more fully explained. Here the topographic conditions are controlling, and very large districts exist where there is no runoff, and other districts where the runoff is very slight, it being found only in storm-water streams and very infrequent springs. We may divide this district where the runoff is from 0 to 2 inches into three portions, which appear to be nearly equal. As determined by topographic conditions and diminished rainfall, one-third will have no runoff, another third will have a runoff of 1 inch, and the remaining third a runoff of 2 inches. If all of this water could be caught and used upon the land in irrigation, then on the land where there is no runoff there would be no irrigation; on the second portion, where the runoff is 1 inch, one acre in twenty-four could be irrigated; on the third portion, where the runoff is 2 inches, one acre in twelve could be irrigated.

ABSOLUTE CATCH AND POSSIBLE CATCH.

So far we have considered the problem only on the supposition that all of the water can be caught, but this is not possible. This total runoff we will call the absolute catch, and we will now proceed to find the possible catch, the practical catch, and the crude catch, as we have defined the absolute duty, the possible duty, the practical duty and the injurious duty of water.

The water which is used in irrigation must be caught. The season of irrigation is short as compared with the remainder of the year. All the water which is not used as it is caught must be stored in reservoirs; but from these reservoirs a part of the stored water will evaporate, the amount varying in different latitudes and altitudes from 50 to 100 inches annually. That is, if a reservoir has a surface of 10 acres, then 10 acres of water 50 to 100 inches in depth will be evaporated annually. It is not possible, therefore, to hold all the water stored; but if we suppose that the catch of the waters be perfect, which can be effected only at an enormous and impracticable expense, then the possible catch is that which is used immediately after being caught and that remaining in the reservoir after evaporation. This possible catch will be 30 per cent. less than the absolute catch.

Space does not here permit of a discussion of the facts which lead to this conclusion, and only the simple statement is made. The possible catch, then, is 70 per cent. of the absolute catch.

THE PRACTICAL CATCH.

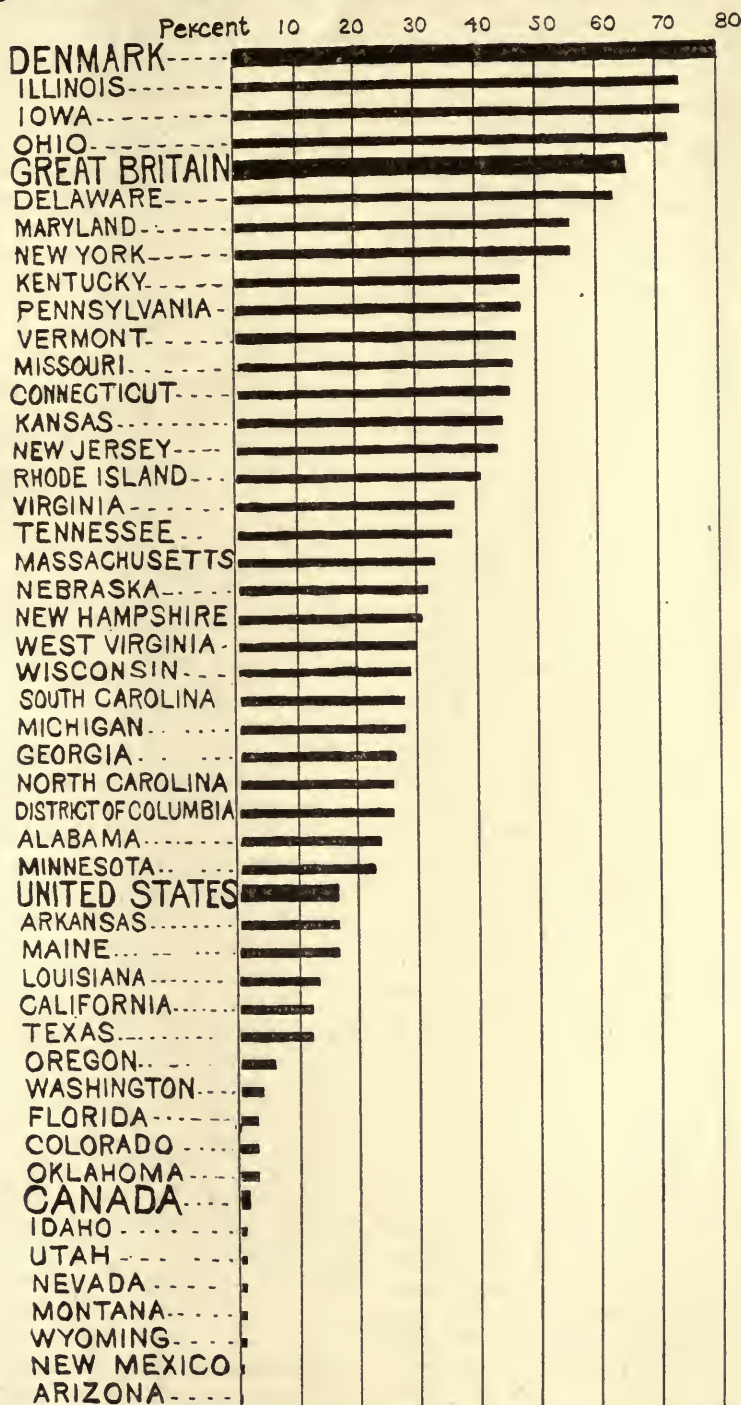
The possible catch is impracticable by reason of excessive cost; and we have a further reduction to make. Where the catch is concentrated by greater rainfall and most favorable conditions of topography, the practical catch is comparatively large; where the rainfall is less and the topographic features more unfavorable, the practical catch is very small. It will never pay to impound the storm waters of sand deserts; it will never pay to impound the storm waters of bad lands; it will never pay to impound the storm waters of land of volcanic scoria; and there are many other minor conditions of storm-water catchment which are inhibitory. Storm waters can rarely be caught at a practical expense where the rainfall is less than 12 or 15 inches. All such waters must therefore be neglected as not entering into the problem of catch. But where there are mountain lands which condense an amount of water greater than the adjacent lowlands, and where at the same time the catchment surfaces are topographically advantageous, very large quantities of storm waters may be secured; but to a large extent they are added to perennial streams and their catch therefore depends upon the control of perennial streams.

LIMITATIONS UPON CULTIVATION.

There is still another important factor to examine in this connection. Rains fall in intermittent storms. Some showers are gentle and furnish small amounts of water; some great storms furnish large quantities of water. The maximum storms which cause destructive floods fall at intervals of years. Now it will never be practicable to catch all the water of maximum storms, because of the great expense of constructing the necessary works. On every stream where works are constructed for diverting the water, spill-ways are necessary to provide against the maximum storms. Practically it will be found economic to waste all the water of storms which much exceed the mean, and these are the rains which serve greatly to increase the run-off.

We have, then, to deduct from the possible catch that portion of the storm-water streams which must be neglected, and that portion of the great storm floods which will be spilled, which together amount to about 30 per cent. Thus the possible catch will be reduced to the practical catch. The reason for reaching this conclusion cannot be entered upon here for want of space. It is thus found that there are inexorable conditions which limit the amount of land which can be practically cultivated in the arid region.

PROPORTION OF IMPROVED LAND TO TOTAL AREA



The practical catch and the practical duty of water set these limits.

HOW MOUNTAINS EFFECT RAINFALL.

Before proceeding to apply these laws in estimating the amount of land which can be irrigated, another important fact with regard to the water supply should be pointed out. Mountains concentrate the rainfall. Both maps serve to bring out this fact. Thus, in the great system of the Park mountains of Colorado, in the Wasatch and Uinta mountains, of Utah and Colorado, in the Black Hills and the geyser mountains of Wyoming, stretching up into Montana, and in the great mountain systems of Montana and Idaho, large areas of increased rainfall are found. Again, in central Washington, Oregon, and eastern California, the Cascade mountains and Sierra Nevada furnish another example of increased rainfall. This gives to the arid lands of these states where irrigation is necessary, large streams of water having their sources in the mountains where the rainfall is great and the runoff is also great. In the upper regions little or no irrigation is necessary, and only small areas can be cultivated because of the mountainous character of the country. These mountain-born waters, therefore, may be used upon the mesas, plains and valleys below. This gives to all of these districts a large source of water supply, which is often limited only by the distance to which it can be practically carried in canals. In making a general statement of the amount of land which can be irrigated in the United States it is necessary to consider these facts also.

AMOUNT OF LAND THAT CAN BE IRRIGATED.

It is proposed now to consider those areas of country in the western half of the United States where the rainfall is 20 inches or less. There are large districts of country which can be profitably irrigated where the rainfall is more than 20 inches, but for present purposes these are neglected.

The total area where the mean annual rainfall does not exceed 20 inches is about 750 million acres. Where this is situated is shown on the map of Mean Annual Rainfall. The water to be used in irrigation in all of this country, with some slight exceptions hereafter to be noted, is the natural runoff from the same areas, to which must be added the amount of water caught in the mountain regions where the rainfall is more than 20 inches, but which runs down where it can be taken upon the lands having 20 inches of rainfall or less. When we compute the absolute runoff of all of this region, it is found that if it could be all caught and all distributed upon irrigable lands at the rate of 24 acre-inches to every acre of crop, the amount which could thus be irrigated would be about one-tenth of the whole, or 75 million acres. But this supposes an absolute catch, which is

impossible. Reduced to the possible catch (which is not practical) the amount is a little over 52 million acres. This reduced again to the practical catch gives a little over 36½ million acres. This, then, is the amount of land in the arid region where the rainfall is 20 inches or less which can under practical conditions be redeemed for agriculture by irrigation through the use of the natural runoff. But to redeem it, all the practical catch from the arid region and from the mountains which deliver their water into the arid region must be utilized.

In the above estimate only the natural runoff has been considered. We must now turn attention to other sources of water to which reference has been made from time to time.

It will be seen that in making this estimate it is proposed to transform runoff water into flyoff water through the agency of growing crops and the evaporation consequent on the processes of irrigation. Now a portion of the natural flyoff can be caught before it is evaporated and can be used in irrigation.

SUPPLIES BY PUMPING.

First. Some of the rainfall sinks away into the earth, where it in part runs off by springs, but in chief part by slow evaporation, coming to the surface by capillary attraction. This water which sinks into the soil can be utilized as an important supply, adding to the total only a small percentage, it is true, but when measured in acres the amount is worthy of consideration. Into the surface soils and rocks wells may be sunk and the water may be pumped upon the land for irrigation. The actual experience of mankind throughout the world exhibits the fact that millions of acres are thus cultivated. The tracts redeemed by single wells may be small, but such pump wells in the aggregate furnish considerable quantities of water, even in measures which irrigation requires, by acre-inches and acre-feet.

ARTESIAN WATERS.

Second. Waters which sink away underground are often carried to considerable depth, and may be returned to the surface by hydraulic pressure under proper geological conditions. These supplies are known as artesian waters. In the practical operations of irrigation throughout the world, it is found that artesian wells may be made to supply considerable quantities of water for irrigation. Single artesian wells furnish on the average much greater quantities than single pump wells; but artesian wells are successful only under greater intervals of areal space.

FLOODPLAIN WATERS.

Third. Along the course of storm-water and perennial streams there is usually found a floodplain—a belt of country on either side of the stream which receives the overflow from the stream when great

storms occur that swell it beyond the capacity of its banks. In such floodplains accumulations of sand and gravel are found irregularly distributed among soils and clays. These sand and gravel deposits become natural reservoirs for water, which comes down in part from the adjacent hills, but in larger part from the great floods. Now, these floodplain waters can be secured for irrigation, either by tapping them with canals that lead to lower ground, or by sinking wells and pumping out the water. In actual practice both the gravity method and the pump method are used, but in general the pump method is found more economical.

The irrigable area of the arid region can therefore be increased from these three sources, but the quantities cannot be exactly defined without most thorough geological research. Some districts will afford much, some little, by reason of varying geological conditions, but actual experience proves that the amounts are considerable and worthy of notice in such an account of water supply as we are now giving. It seems probable from the general experience of other lands that three or three and a half million acres may be added to the total for the arid region by the use of pump waters, artesian waters and floodplain waters. This, then, will give to practical irrigation in the arid lands where 20 inches of rainfall or less is found a total area of forty million acres.

AMOUNT OF LAND UNDER CULTIVATION.

In no civilized country is all the land cultivated. Denmark has the greatest amount, where 75 per cent. is under the plough. The accompanying table exhibits the proportion cultivated in different states and territories of this country. Denmark, Great Britain, Canada and the total for the United States are interpolated in appropriated places for comparison. When these 40 million acres are cultivated by methods of irrigation they will be found wonderfully productive, and their products will support a population as great as that found in the United States at the present time. It must be many decades before it is all redeemed. As from district to district farmers come nearer to the realization of the practical catch as here represented more refined methods of catch will be adopted and the practical catch will be increased; but this will not result in increasing the acreage cultivated, for at the same time better methods of irrigation will be developed, from which a greater production will result and which will require a greater practical duty of water. In fact, it seems probable that intensive agriculture by increasing the product will decrease the acreage, so that the total amount here estimated will never be realized.

A word must be said about the character of this

investigation and the degree of probability which inheres in its results.

In measuring rainfall and runoff, only averages can be given. A farmer sells a field of corn standing in the shock. In order that he may establish its value, he husks and measures a few shocks and derives therefrom an average which controls the quantity in the terms of the sale. The average thus obtained will never, except by accident, be exactly that of any one shock of corn, and yet an approximation to accuracy will be reached sufficient for practical purposes of trade. In like manner, the statements made in this paper are rarely if ever absolutely accurate for any one small district of country, and the quantities must always be taken as mean quantities, which only approximate accuracy. The investigations have been carried on but for a few years, and to be complete by small districts it would be necessary greatly to multiply the stations for rainfall gauging and stream gauging. Notwithstanding all this, the general averages may be taken as approximately safe.

Most of the lands now irrigated are watered by streams and irrigating works that do not require the most expensive plants; that is, the small streams are nearly all taken out upon the land, and a small stream irrigates a small area at a correspondingly small total cost. As irrigation is extended, larger and still larger plants are generally, though not always, necessary, and for this purpose aggregated capital is necessary. This capital will sometimes be secured by coöperation among the irrigators themselves, and sometimes capital will itself lead the way, for the purpose of increasing the value of lands and selling the same with water-rights to the farmers. Whatever method is pursued, aggregated capital must be employed. Therefore the farmer and the capitalist alike are interested in these results. Before money or labor is to be invested in irrigating works, it becomes necessary to consider the water supply. Is there land? is the first question raised; Is there water? is the next question; and Can the water be carried to the land with reasonable economy? is the third. Many canals have been constructed without a proper consideration of these three questions, and already capital has been wasted, and we have now reached a time in arid America when these three primary questions relating to irrigator enterprises should be properly answered, before lands are bought and sold, homes established, labor organized and capital invested. Without these precautions bonds are worthless.

In the next annual report of the Geological Survey the subject of this article will be treated at length and the facts arrayed in a more elaborate manner.

THE ART OF IRRIGATION.

ERRORS TO AVOID—METHODS OF MEXICO AND ITALY.

CHAPTER II. BY T. S. VAN DYKE.

FROM what your attention was called to it in the last chapter, it is easy to see that for the best results the whole ground should be uniformly wet, neither so dry on one side of a plant as to throw on the other the labor of furnishing all the water necessary for perspiring, nor so wet on the other as to prevent full circulation of air through the soil. It is equally plain that if any given part of the territory through which the roots range is too wet at one irrigation and too dry at another, they will be kept working unevenly and cannot do full duty. And any deviation from sound principle in these respects will tell as surely as fate in either the quality of the fruit or the percentage of the first grade, and generally in both.

Though I have used trees so far by way of illustration, the principles apply as well to everything else. There will, of course, be cases where you will have to do imperfect work, because the nature of the crop will not justify too much care or labor. But it is quite necessary to keep bad work from being too bad, and the surest way to do so is to study the principles that make perfect work.

The natural desire of the irrigator is to imitate rain. Nothing so uniformly wets the whole ground as fine rain, and nothing irrigates so well as a watering-pot within its limits. If you only had one big enough, with water enough in it, and someone to hold it, you would be fixed. But all attempts to irrigate on any considerable scale by sprinkling will be a failure unless the arrangements are very expensive, and even then they may be inferior in the long run to something much simpler. The difficulty of maintaining anything like a uniform pressure on the great number of openings necessary for extensive sprinkling lays this system at once out of the list of practical ones, except for a few things and on a small scale.

Finding sprinkling out of the question, the next idea of many is to cover the ground evenly with a thin sheet of water. Very fine if it would only work. But no ground is found in condition for doing that, and it seems quite as hard to put it in condition as to find it so. If made perfectly level then the water refuses to run or spread very far over it unless it is rammed down flat and smooth. This is just what you don't want, for then it won't soak water well and will bake twice as hard in half the time when the water is taken off. If the ground is made soft and fine, so that the water may readily enter it, and the slightest slope given it so that the water may spread over it, then it displays a remarkable perversity in making little

channels, which it follows, leaving the rest about dry. And if the slope be the least bit too great, then these channels cut and wash so rapidly as to make the irrigator incline to wish he had never been born.

Finding too great the labor of imitating a fine soft rain, either by sprinkling or by a thin blanket of water over the whole, the beginner naturally drifts into letting the water have its own way and planting things along its course where the nature of the crop will permit, or else of making dams around the stuff to be irrigated so that the water will stand in a series of ponds or basins until it soaks in. Into one or both of these methods all early irrigation in all countries naturally drifts. And in few of them is any great advance made for a long time. Both of these methods may be seen in use to-day in many parts of Mexico, and all the early irrigation in California was of this nature. In Mexico the peons have in many places developed the system of small dams or checks into a pretty effective plan. I have seen very good wheat raised that way and very fair work done, but the greater part of the work I have seen there on other crops, and especially in the orchards and gardens, is of the most primitive type of letting the water take care of itself and planting stuff to suit its vagaries. The old-time garden, of which many examples could be seen in California a few years ago, and many of which may be found in all parts of Mexico to-day was a bit of land over which the water crawled in channels of a thousand curves and stood in puddles of a thousand sizes. Everything was planted to suit its whims, here a row of beans on a line that would make a well-bred eel sick with envy, there a row of corn that would puzzle the Reverend Nicholas to tell where it begun or ended, and here, there and everywhere, mixed up higgledy-piggledy in the same grand muss, trees of all sorts with vines and bushes innumerable. From year to year and age to age the course of the water is not interfered with. The same old dry bump that was there a century ago is there yet. Nothing ever grew on it, and it would take but a few minutes to level it off so that it could be wet, but there it still is and will be in the centuries to come. So will the elbow that in a few minutes could be cut through so as to give the water a more effective course. The great great grandfathers have stepped across it and the great great grandchildren will die without cutting across it. And yet the results of this work are far greater than one would suppose. But it is in spite of carelessness and not because of it. The

water is either warm or muddy, and generally both, and the ground is so warm and fertilized by its use that the results of even this defective work are often greater than those of the richest soil where the dependence is on the rainfall direct. The ground is never touched with a plow or anything that could break its surface, yet the fruit hangs quite plenty on the trees, and much of it is of fair size. Weeds and grass grow all through it as they did in the ages past, yet the flavor of the fruit is pretty good. The success only goes to prove what a great success it might be if the water were properly handled.

On a larger scale we see the same work and often with remarkable results. Near Lerdo in the State of Durango are many thousands of acres producing heavy crops of corn and cotton. Fields of one hundred acres and often more lying nearly flat are flooded from a large ditch at the upper side from which the water is allowed to flow from many openings. It crawls and spreads over the field in a thousand little sloughs, bayous, lagoons and ponds covering perhaps two-thirds of the whole surface, and often more. The rest of the ground gets wet by seepage from the wet portion as best it can. All the stirring the soil ever gets from century to century is a furrow made in the spring with a wooden plow. This is a round log sharpened at one end and dragged by an ox or two and runs just deep enough to turn over enough dirt to cover the seed which is planted on the hard, smooth bottom the log has left. I saw crops there of corn that would easily average fifty bushels, but it proved only that a hundred could have been raised. I have seen a hundred and ten in California with less water and more work on soil in every way inferior.

The success, such as it is, attained by these methods, which prevail all over Mexico as far as I have seen, is due to the great fertility of the soil, the warmth of the ground and water and a favorable texture in the soil. On heavy clays it would be almost a failure and on soils too porous, through which the water could easily drop without spreading sideways, it would also be quite inefficient on account of the dry parts failing to take up enough water. And under the best conditions the success reached is so far behind what it could be that it can be used only as an example of error. The very best orchards are like the eastern apple orchard referred to in the first chapter, very fine to one who had never seen anything better, but nowhere beside the fine work of skillful irrigators in the Western United States.

In California when the great American came to the front some of the new masters of the land fell at once into the old Indian methods of irrigation, while others started to show them how the thing should be done. Most of them concluded that they would at least straighten the track in which the water was to run and would also plow the ground before planting so as

to give the water a chance to soak in. Which the same was all very fine as far as it went. But there they stopped.

The American thought if a little water was good, more must be better, and into the furrow he turned water enough to fill it and retired to the shade to roll a cigarette. The water generally went tearing down the furrow, cutting away the finer parts of the soil here, breaking out of the furrow there, and occasionally making a fine pond in which the sediment was perhaps deposited. The stream ran muddy with velocity from excess of water and puddled the sides of the furrow in a few minutes with a fine paste that prevented much of the soaking the soil needed. When done the whole was a series of small swamps and dry ridges. The wet parts were mere sheets of paste a few inches thick. Where the soil was sandy enough to permit soaking to any depth the water generally dropped through the bottom of the furrow and went straight down without spreading much on the sides, so that the irrigated portions of the patch were only the parts actually covered by the water and a few inches around the margins.

Under the clear bright sun of the long summer the ground soon began to bake. The second or third day the fine sheet of clay the water had made on the surface by leaching out the finer particles of the soil began to shine and crack in all directions except where it should have cracked, which was around the stalk. Just where the ground around young and tender plants needs aerating the most, around the stem, it formed an impenetrable shield, and where the stuff was young enough it lifted much of it out of the ground as neatly as if that had been the object of irrigating.

The American looked at it and swore, but with true Yankee ingenuity he arose to the occasion. He poured on more water.

Some may think this was from laziness. In some cases that would have been a sufficient reason, as it is in many cases to-day. But the plain fact remains that in most cases it was the only remedy he thought of. The idea of loosening up that top soil with any kind of an instrument to form a mulch to retain the moisture, and admit the air into the soil, never entered his head any more than it did that of the man who used the same stream a hundred years before, and people will begin irrigation to-day and continue it on exactly the same lines if their ignorance only has half a chance.

In no case was more than one stream between two rows of anything thought of in the early days of California. A furrow was made on one side of a row of trees which was left there from year to year and in most cases never broken up. Then there was no furrow until you reached the next tree. The whole intermediate space was a mass of weeds, grass, mus-

ard, briars, or anything that happened to be on the ground when Columbus landed on the other shore.

This one furrow wet only one side of the tree or vine. In many cases it did not even do that, for the run of water was too short to allow it to penetrate anything but very sandy ground to any considerable depth. The roots were coaxed nearly always to the same place, and that a limited area in which they were balled up and knotted and tangled in all sorts of ways. Generally one-half and often two-thirds or more of the feeding ground the roots should have had was so dry during the summer that all the fine roots that had entered it after it was wet from the winter rains, and while the moisture was receding were killed off with dryness.

But this was not the worst of it. Until one has seen it no one can believe how quickly ground that is never cultivated will dry out under the hot sun and dry air of most of the irrigating countries. But this is not half so surprising as the speed with which a piece of dry, hard, uncultivated ground will

sap the moisture from an irrigated piece beside it, especially if the latter is uncultivated. So long therefore as only a part of the tract was irrigated instead of the whole the dry parts quickly sapped the moisture from the wet ones which were much less in area. This made a debatable land between the wet and the dry into which the new roots were being coaxed at each irrigation only to be killed off by drying.

This alone was an injury to the tree by keeping it working for nothing, but it was made worse by the fact that one dose of water rarely wet the exact area that the last one did. Either from the cutting or puddling of different parts of the ditch or the different periods of time the water was run, or from a change of the ditch by accident or purposely from one side of the tree to the other, the portion of the ground becoming sufficiently saturated to do good service was not always the same and the tree was injured by having constantly to accommodate itself to new conditions.

(Continued in next number.)

PERMEABLE TILE TO SECURE WATER FROM THE UNDERFLOW.

By J. W. GREGORY.

INCREASING interest in irrigation on the Great Plains and the recognized importance of securing water from the underflow have led to inquiry into the feasibility of using ordinary porous drain-tile laid in the saturated, sandy substrata of Plains watercourses, for the purpose of obtaining water—just as the same sort of tile is used further east for carrying off surplus water from the soil.

The following is a repetition, in substance, of the answer made to an inquiry from a gentleman in southern Nebraska relative to the advisability of laying such tile conduits and it occurred to me that the matter might be of interest to others:

I do not see how there can be any question that water may be obtained in this way, if the tile is properly laid. The effectiveness of permeable tile in collecting water from underground sources is thoroughly established. But, in laying tile in the fine sands, which form so large a part of the medium in which our underwaters are found, it will be found absolutely necessary to lay only flawless tile and so that the joints shall be and remain perfect. Otherwise the sand will, sooner or later, choke up the conduit and failure and loss will result. No tile should be laid having the smallest hole through its side, or having the smallest piece chipped out of an end, so that an absolutely perfect joint can not be made. Extra precaution will also be necessary to prevent the rolling or slipping of the tile after it is laid—in the process of covering, or afterward, and I am convinced that laying the ordinary tile, in the way it is laid in

loam or clay for drainage purposes, will prove unsatisfactory in the fine, lively sands of variable texture from which the water must be secured, in most cases. It will be necessary either to use tiles having a collar at one end so as to form a slip-joint, or to have bands to slip over the joints, or to take some other precaution to insure that the ends of the tiles shall not slip past each other. This point might be effectuated by underlaying the ordinary tile with stringers of plank or scantling, in many cases. The safest plan would be to use two sizes of tile, one fitting inside of the other closely, care being taken to break joints.

In this way, displacement either by rolling or slipping would be effectually prevented and any chance flaw in a tile, which might be overlooked, would be covered by the other tile, over or under it. While this would materially increase the first cost of such a conduit, the difference of cost would be more than offset by the certainty and permanency of results. If such a conduit is laid in the bed of a channel through which flood-waters pass, at any time, care should be taken to have the tile buried deep enough to be safe from washing out or being disarranged by torrents. It would be well to avoid, as far as possible, laying such conduits across the course of any such stream, if the bed is composed mainly, or in places, of fine sand, because such sands move and shift to considerable depths in times of flood, and the conduit if laid across the course of any the stream, is much more likely to be disarranged and consequently filled up, than if laid parallel, or nearly so, to the flow of the water.

A POLICY FOR FRUIT-GROWERS.

COMBINATION IS THE PRICE OF THEIR PROSPERITY.

THE most important single industry which has grown up under modern irrigation in the West is fruit-growing. In this term is included the production of all the citrus and all the deciduous fruits, as well as the fruits of the vine. No other industry has given such an impulse to the settlement of irrigated lands. A fruit farm is invested with a certain charm which appeals powerfully to the imagination of those who have not been bred to the soil. Fruit growing in the West seems to represent the exact reverse of farming as it is known in the East. The one stands for a life of comparative ease, and the other for a continual round of the hardest sort of manual labor. This is the explanation of the fact that a very large proportion of those who have made homes in the irrigated West have planted trees and vines.

THE BUSINESS HAS BEEN PROFITABLE.

Fruit-growing has been a source of phenomenal profit in the past few years, especially in California. There have been a few instances in each community where growers, owing to peculiar skill and intelligence, have realized very extraordinary profits, and while the profit of the average grower has been quite satisfactory, the possibilities of the business have been generally estimated on the basis of the very highest results enjoyed. This has been an important factor in stimulating the sale of lands and the planting of new orchards.

THE DECLINE OF PRICES.

It is a well-known fact that the profits of the fruit industry have sustained a decline during the past two or three years. This has been true of every product in the list, from raisins to oranges. The point has not yet been reached where no profit is realized, and there are those in every community who still obtain very fair prices, but it may be said of the industry as a whole that the tendency has of late been steadily in the direction of lower quotations, and that the depression is such as to cause some solicitude about the future of the business. The most natural comment upon this situation would be that when every community and every industry, not only in the United States, but throughout the world, is depressed, the producers of fruit could not fairly expect to be exempt from at least a share of the evils of the times. This is certainly a reasonable view, but it is none the less incumbent upon those who have invested in the business, and who look to it for their support, to make a

careful study of existing conditions, in order to ascertain in what measure the falling prices are due to the general depression, and in what measure to other causes which it may be in their power to remedy.

COMBINATION AMONG THE GROWERS.

The most interesting movement on foot in the West to-day outside of the great movement for the reclamation of the new areas of arid land, is the projected organization among the fruit-growers of California. They have studied the situation and come to the conclusion that they are being imposed upon by commission houses, who have organized a system which amounts to a conspiracy to rob the producers. This is a matter of very vital interest to readers of THE AGE throughout the West. Holding this view of the case, THE AGE has been at some pains and expensé to make an investigation. To present the matter intelligently as it appears upon careful study, and to enable the reader to take broad views of the future of the industry as it affects Western America as a whole, requires us to go briefly into the history of the rise and progress of fruit-growing as a distinctive business.

I.—RISE OF THE FRUIT INDUSTRY.

The modern fruit industry was the outgrowth of what may be called the second era in the settlement of California. After the subsidence of the mining boom, which gave the first great impulse to the settlement of the Pacific coast, attention was turned to the cultivation of the soil, and the wonderful capabilities for the production of all the fruits of the tree and vine were quickly discovered. Intelligence and enterprise were brought to bear upon the business, and this resulted in the rapid development of the best methods of cultivation, of preparation for the market, and of facilities for profitable shipment. The business was first developed on a large scale in the beautiful Santa Clara valley, which soon became famous for its prunes. About the same time the Sacramento valley entered extensively upon the cultivation of the peach, which immediately became a very profitable crop. The next distinct phase of the industry was manifested at Fresno, in the heart of the San Joaquin valley where attention was largely devoted to raisins. Colonies sprung up almost like magic and the Fresno raisin became a well-known article of commerce, yielding high prices and handsome profits to the planters. This development assumed importance

about eight years ago. At the same period, or one or two years later, Southern California began to attract an immense amount of attention by its success in the production of citrus fruits. It also became a competitor of the northern and central valleys in the output of peaches, apricots, raisins, walnuts, almonds, pecans and all other products of the semi-tropics.

THE RESULTS OF PROSPERITY.

The results realized from the introduction of scientific methods of cultivation were very gratifying to all concerned. The first effect was seen in the division of large land properties into ten, twenty and forty acre fruit farms. This resulted in an rapid increase of population in the localities affected, both urban and rural, for the cities and large towns were naturally built up as the surrounding country was filled with prosperous producers. There were profits for real estate operators, profits for fruit-growers, profits for nurserymen, profits for railroads and profits for tradesmen in the towns. But all this was based on sound industrial development. Everybody prospered because new values had actually been created. Something had been added to the volume of commerce, and the money distributed through all the channels of trade and industry was real wealth, which came primarily as the result of applying honest labor to good soil. The reckless town booms which preceded this industrial evolution naturally came to grief. They were based entirely on fictitious profits, existing only in the fevered imaginations of speculative minds. When the collapse came it was perfectly logical. But no such explanation can fairly be offered for the decline in the prosperity of the fruit industry, as it is not generally true that land was sold for this business upon an unreasonable valuation.

HOW OTHER STATES ARE AFFECTED.

The results of California's prosperity in the fruit business extended far beyond the boundaries even of that State of imperial dimensions. Thus it happens that the problem with which California fruit growers are now dealing is a matter of broad interest wherever *THE AGE* is read in the West. The California fruit industry became a type for many other States and Territories. While the California climate confers especial advantages, there are other localities in the semi-tropic belt, and not only that, but California methods of producing and marketing fruit are applicable to the business when pursued in the temperate zone with hardier fruits. For instance, an enterprising irrigation company in Colorado has adopted the California plan in developing ten-acre fruit farms near Denver. The same plans are being put into operation in Washington, Oregon and Idaho. Utah is another field in the temperate zone which is deeply interested in this problem. The southern portions of New Mexico and Arizona are basing their hopes

largely upon the wide adoption of California methods by their people. So it happens that the California fruit situation can only be intelligently considered by a journal of general circulation, like *THE IRRIGATION AGE*, with reference to the various parts of the arid region which are capable of producing the deciduous fruits in abundance. If there is any reason why the industry is not to be profitable henceforth in California it applies with equal force to other localities that are as deeply interested prospectively as the older State is actually.

A VERY BAD MISTAKE.

Before proceeding to the consideration of what the Californians regard as a chief cause of the present situation, it is well to point out one or two serious mistakes chargeable to no one except themselves. It cannot be denied that the raisin market was injured by the shipment of a damaged crop two years ago. A great reputation for the Fresno raisin had been laboriously built up after years of effort, and this reputation was seriously impaired by the over-shrewdness of a small number of growers who managed to sell damaged raisins on the strength of their good name. The natural result was complaint and lower prices. The Riverside orange-growers were guilty of the same stupid blunder when they shipped a frozen crop two years ago and sold it under cover of Riverside's exalted reputation. In both instances a little temporary gain was purchased at the expense of large permanent loss. A reputation achieved by years of hard work may be spoiled in a day. These mistakes are not likely to be repeated. To see that they are not repeated is one of the important things he producers have on hand at present.

II.—THE CAUSE OF LOW PRICES.

A study of the California fruit industry thus involves the consideration of the future of the business in all the States and Territories of the Rocky Mountain region west to the Pacific ocean. The commonest explanation of the present situation is that it is due to overproduction. This excuse is not acceptable for several reasons. The United States still imports a considerable quantity of all kinds of fruit. Furthermore, the home markets of the East and central West are still rapidly expanding. On the other hand, the production of fruit from the old, wornout lands and orchards of Eastern States is steadily declining. There is, therefore, no reason to believe that the business in the West has begun to approach its natural limitations.

UNDERCONSUMPTION, NOT OVERPRODUCTION.

It is a more difficult thing to estimate to what extent and with what rapidity the consumption of fruit will increase *per capita*, but the most casual study is sufficient to indicate that the average family will

consume much more than it now does if encouraged to do so by lower prices at retail stores. Many kinds of fruit have high value as nutriment; all kinds are relished as palatable. In older countries the consumption of fruit *per capita* is much larger than it is here, and statistics show that the tendency has been toward a steady increase on the part of the American public. This tendency is likely to continue with improvement in the quality, increase in quantity and reduction in cost at retail stores. Thus the bugbear of overproduction must give place to the substantial fact of underconsumption.

THE COMMISSION SYSTEM.

The decision of the California fruit-growers themselves, after the most searching examination they could give it, is that the chief trouble lies with the commission system. It is freely charged, and generally believed, that commission houses do not deal honestly with the growers. This is one of those charges much easier made than proven, but it is at least certain that the opportunity for the grossest injustice exists, whether it be taken advantage of or not. The commission house occupies the wide space between the grower and the consumer. It has grown to be a large and important part of the machinery of the fruit industry. It represents a comparatively small investment, but bears every evidence of having enjoyed a disproportionately large share of the profits. "Let me control the markets and I care not who raises the fruit" is an appropriate adaptation of an old line. Whoever controls the markets is certainly in a position to make the business net a profit or a loss to the numerous, scattered and unorganized class who raise the fruit, and whose aggregate investment in the business is enormous.

IS THIS THE WAY IT IS DONE?

It is the custom of commission houses to make contracts under which they advance money on the crop and then agree to handle it at the owner's risk, disposing of it according to their judgment and returning the proceeds of the sale to the grower, less expense of handling and commission. It is charged that fruit is often sold to purchasers who are merely the dummies of the commission men, and that the genuine sale to wholesaler or retailer is made on much better terms, the profit on the transaction going into the pockets of the commission men. There are those who claim to be able to prove to the satisfaction of unprejudiced minds that this is the actual mode of operation. THE AGE does not pretend to be able to prove it, and it does not seem important to do so.

NO DOUBT ABOUT THIS FACT.

For our purposes it is sufficient to know that while the prices realized by the producer have steadily declined, the prices paid by the consumer remain the

same as formerly, and are large enough to pay the grower very handsome profits if he received his fair share of it. This assertion is susceptible of proof. THE AGE has conducted an investigation at its own expense, sending a representative to Cincinnati, Washington, New York City, Minneapolis, Chicago and other points, to ascertain what the public is paying for dried peaches, apricots, raisins, prunes and other products of irrigated lands, for which growers are receiving much smaller prices than they have a right to expect. There is something to be said for the commission men's side of the case, and this shall be fairly stated.

WHAT THE CONSUMER PAYS.

Among others, our representative interviewed John Wilkin, of 254 Grand street, New York. California dried peaches, such as growers have been selling at 5 or 6 cents per pound, were tendered at 30 cents per pound, and apricots at 25 cents. Mr. Wilkin was asked what price he would quote per hundred, and replied that he could give no discount, as the margin of profit was very small.

The firm of Hamburger & Newburg, 126 and 128 Sixth street, Cincinnati, quoted the price of 30 cents per pound. They were closely pressed for a price on 100-pound lots, and finally named 25 cents, remarking, "But that leaves us a very close margin, indeed."

A canvass of several of the best groceries in Washington, D. C., found apricots 20 to 25 cents, peaches 25 cents, prunes 15 to 18 cents, raisins from 25 to 40 cents.

In Minneapolis, M. H. Cassidy, 1318 Sixth avenue, north, quoted dry peaches, prunes, raisins and apricots, all at 15 cents *wholesale*. Minneapolis retail stores quoted peaches at 20 to 25 cents, apricots at 16 to 18 cents, prunes at 15 to 20 cents, raisins at 10 to 30.

In Chicago there are many large stores that make runs on special lines of goods, and among these it is easy to occasionally get quotations that tally with the present prices received by growers. But the average price paid by consumers for California dried fruits in Chicago is from 20 to 25 cents.

The commission house claims to realize but half a cent for its services; the freight figures less than 2 cents. What becomes of the rest of the money representing the difference between the price received by the grower and the price paid by the consumer? There are from 15 to 20 cents per pound to be accounted for. If the wholesaler or retailer, or both together, realize this profit, while the meek commission man sets humbly by and sees them do it at the expense of his client, the grower, it is certainly very odd.

WHAT COMMISSION MEN SAY.

THE AGE has waited upon some of the leading California commission houses and asked them for an

explanation of existing conditions. A composite photograph of their views looks as follows:

"Overproduction is the trouble. The planting of trees and vines has been stimulated to abnormal proportions by the policy of California real-estate dealers. A few years ago a few men of superior intelligence in certain localities produced fruit of extraordinary excellence and received for it extraordinary prices. These few individuals realized very great profits per acre, while the average grower received very fair prices. The real-estate dealers immediately exhibited the results of the phenomenal cases and declared them to be just a fair average of what anybody could do on any kind of soil anywhere in the golden State of California. The result was a great impulse to the planting of orchards, overproduction and a very natural decline in prices. You will find by inquiry that in many instances dried fruits are selling from 7 to 10 cents per pound at retail stores. Wherever they sell for such quotations as you have obtained, it is due to the fact that people do not insist on close prices for such articles as they buy in small quantities, as is the case when they buy butter, eggs and other necessities. In such cases the retailer makes an unreasonable profit, but what are we going to do about it? We have given the grower the benefit of the best prices the market would afford in view of the enormous production of fruit on one hand, and the prevailing depression on the other. We have dealt honestly with the growers, but they would not be satisfied if they had 75 cents per pound."

III.—ORGANIZATION THE PRICE OF PROSPERITY.

Whatever the cause of existing conditions, they have grown up under the commission system. There is no reason to believe that matters will improve while that system continues to occupy the commanding place in the machinery of the industry. Now, the commission house is theoretically only the agent of the grower. Actually it is his master, and whenever the agent becomes the master, it is the part of wisdom to dispense with his services. Is it possible to find a better agent, one who will be accountable to his employers, whose transactions will be open to scrutiny and who will have no private interest inimical to the interest of those he is paid to serve to the best of his ability? The agent, of course, is a necessity. The individual grower cannot personally dispose of his product in the eastern market, nor maintain private offices and representatives to deal with the trade. But can growers do this collectively? Unquestionably they can if they will pool issues in good faith and stand firmly together, and this is precisely what they are now trying to do.

ORGANIZATION WELL UNDER WAY.

The organization of town and county unions among fruit growers has been rapidly going forward of late. It is believed that they can be brought together in a strong and enduring State association. A very clear statement of the aims and objects of the latter body is contained in the following extract from the report of Manager Edward F. Adams to the California Fruit Exchange:

They can ascertain the condition of the markets and the value of their crops.

They can explore and open up new markets and stimulate old ones.

They can procure their own funds for necessary advances on crops, while retaining their sale in their own hands.

They can concentrate, grade and prepare their products for their final market.

Between our fruit thus concentrated and in store in California and the jobbing houses in distant cities, there must, for the present, be a go-between of some kind. Nothing but substantial uniformity of grading and packing, accompanied by clear definitions of grades, certainty that goods delivered will conform to them, and absence of severe competition will enable us to escape this expense; but whenever we have learned to produce those conditions, the mail and the wire will be all the middle servants needed.

That at present the necessary go-between may be with,

1. The jobbers' agent, residing here and inspecting, buying and paying on the spot in behalf of his principal. This form is of course what we would wish.

2. Our own agents, upon salary and expenses traveling among jobbers and making sales. If, however, we take our business from the brokers who now have it they will all work foreign goods instead, and it becomes a mere question of dollars and cents whether we can get men who will sell our entire crop each year, against the competition of those who now sell it, at an aggregate expense below the aggregate of commissions which we could arrange for through brokers.

3. Brokers selling upon uniform commission at prices set by ourselves, the goods remaining in California until sold.

What methods to adopt may safely be left to the judgment of Directors, but my own view is that our policy should be that which will induce the largest possible number of people to engage in finding customers to consume our fruit products, and that it should be known of all men that whoever will bring us a customer shall be paid for it, at a uniform rate.

Dried fruit can be concentrated, graded and packed by growers through local co-operative unions, and in no other way. In no other way, also, can it be put where the grower can obtain necessary advances upon it without parting with control of its sale.

I therefore think that the Exchange should actively promote the formation of such unions throughout the State, upon substantially uniform plans which shall provide for a uniform system of grading and packing, and for such inspection on the part of the State Exchange as may be found necessary to maintain uniformity.

DANGERS TO BE AVOIDED.

There can be no question about the enormous advantages of the new system over the old if it can only be carried out. The experiment is full of practical difficulties, and these should not be underestimated. No chain is stronger than its weakest link, and all coöperative efforts have demonstrated that there are some very weak links in large bodies of individuals. If the commission system is to be

substituted by a system of popular control by the producers themselves it is absolutely necessary that all fruit-growers, or substantially all should be in the organization. And they must be in it to stay through thick and thin, through difficulties and dangers until final success is achieved. A fruit crop is of no value without a market. The commission men control the market and that gives them their strong grip on the situation. But control of the market is worth nothing without a fruit crop. The growers control the crop and are therefore in a position to obtain control of the market if they will stand together in a compact and unwavering organization. Strong local unions are the key to the situation. This is where success will be won and this is where the danger of failure is to be provided against.

Another danger is that cheap men will get control of affairs. The growers should beware of the chronic office-seekers who always try to get to the front whenever honors and salaries are to be distributed. Honest and capable management is vital, and ability cannot be had for nothing. It is another of the proverbial weaknesses of coöperative effort that it is generally attempted to employ men for important positions at small salaries. First-class ability cannot be had on such terms, and nothing less than first-class ability will accomplish the desired results. Loyalty to the

organization, good management, patience in waiting for results—these things will be the price of success.

JOIN THE UNIONS.

But first of all, in order to lay the foundation of success, it is absolutely essential that all the growers should stand together. The man who will not join the movement is nothing less than a traitor to his business and his neighbors. He is a menace alike to his own and his brother's prosperity. He is an ally of the enemy. It is reasonable and right that the strongest pressure should be brought to bear to unite the growers in a solid compact, the aim of which is to foster the common good. No grower can be exempt from the benefits obtained, and none should shirk his share of the responsibility.

ARID AMERICA IS WITH THEM.

THE IRRIGATION AGE assures the men of California that the people of Arid America are heartily with them in their effort to improve the conditions of the fruit industry. It is but a question of time when every other State and Territory will meet the same problems. They will suffer from the same evils, or prosper with the removal of those evils. The Californians are fighting for the West when they are fighting to put their business on the solid basis of prosperity for the men who made that business possible.

A SUCCESSFUL FLORIDA COLONY.

THE spirit of colonial settlement upon a fixed and prearranged plan has reached Florida, and the new colony at Avon Park is reported to be in a highly flourishing condition. The negro question and the liquor question have both been settled already by not having either the negro or liquor in the colony. A select body of land owners have there come together, not wholly upon coöperative lines, perhaps, yet with a common ultimate purpose—the founding of a colony settlement in the pineapple region of Florida which shall comprise many of the attainable features which make life agreeable and worth the living, even in a new and undeveloped region. A good school and a union church are attractive features of the new settlement. No loafers or dissipated persons are allowed to gain a foothold, and industry, sobriety and good citizenship characterize the entire colony. The main industry is to be the production of pineapples, supplemented by such manufacturing and kindred industries as shall be found from time to time to promote the welfare of the colonists.

Such colonial settlements as that established at

Avon Park are quite common in California and some other parts of the arid belt, and it is safe to say that nowhere in the world are found more prosperous and progressive communities. The isolation of ordinary farm life and the frightful congestion of the city are both avoided by the system of colonial settlements which is so fully recognized now as an essential feature in the development of the arid region. With the growing intelligence of the people and a due recognition of the interdependence of one upon another, such coöperative communities will greatly multiply, especially in those regions of the irrigable west where water power may be easily utilized for electric lighting, transportation and manufacturing purposes. No part of the world is better adapted to such settlements of educated and refined people than the arid region of the United States; and the day is not far distant when these centers of the most agreeable and highest types of civilized life on this continent will attract the attention of the world's foremost thinkers, as solving, in a great degree, one of the most complex problems of the century.

THE NATIONAL ORGANIZATION.

NATIONAL EXECUTIVE COMMITTEE ELECTED BY THE IRRIGATION CONGRESS AT
LOS ANGELES, CALIFORNIA, OCTOBER 14, 1893.

CHAIRMAN, Wm. E. Smythe, Member-at-Large. **SECRETARY, Fred L. Allis, Member-at-Large.**
Postoffice Box 1019, Chicago. Los Angeles, California.

VICE-CHAIRMAN, Edward M. Boggs, Arizona. **TREASURER, John E. Jones, Nevada.**
Tucson, A. T. Carson City, Nev.

CALIFORNIA,	Eli H. Murray, San Diego.	NO. DAKOTA,	Dr. Merchant, Ellendale.
COLORADO,	J. F. Roche, Hardin.	OKLAHOMA,	John H. Cotteral, Guthrie.
IDAHO,	T. D. Babbitt, Nampa.	SO. DAKOTA,	J. T. McWilliams, Aberdeen.
ILLINOIS,	Willard E. Allen, Chicago.	TENNESSEE,	P. H. Porter, Nashville.
KANSAS,	J. W. Gregory, Garden City.	TEXAS,	J. J. Walker, Barstow.
MONTANA,	Z. T. Burton, Chouteau.	UTAH,	Arthur L. Thomas, Salt Lake City.
NEBRASKA,	Chas. P. Ross, North Platte.	WASHINGTON,	N. G. Blalock, Walla Walla.
NEW MEXICO,	M. A. Downing, Las Cruces.	WYOMING,	Elwood Mead, Cheyenne.

COMMITTEE ON NATIONAL LEGISLATION,
W. A. Clark, Butte, Montana.
Eli H. Murray, San Diego, California.

Richard J. Hinton, New York City.
NATIONAL LECTURER,
J. S. Emery, Lawrence, Kansas.

PROGRESS OF THE WORK.

THE work of the irrigation propaganda, represented by the national organization, has thus far proceeded no further than the initiatory stage. The State Commissions are in process of organization and some very strong selections have been made in several instances. The commission system will certainly prove a great success if the gentlemen appointed to serve on these bodies devote the amount of attention to the work which it is anticipated they will do. At the next Irrigation Congress the needs of every state and territory, together with their views on questions of national and local policy, will be represented by men of ability and experience. Their reports will be the fruit of study and not the casual expression of the moment. The opportunity which the commission system offers—an opportunity to begin the work of revising and enlarging State laws upon a plan of uniformity and developing a comprehensive national policy with relation to the public lands—should certainly be eagerly accepted by every friend of Arid America. The success or failure of the year's plans, and of the next Irrigation Congress, will turn entirely on the work of the State commissions. If that work is enthusiastically and conscientiously performed the next Congress will have (1) the data which must furnish the foundation for wise policies, and (2), the authoritative expression of the opinions of all the States and Territories. If the work of the commissions is neglected the whole splendid plan of campaign will fall into hopeless ruin. We shall be no nearer the realization of results than we were last October and a precious year will have been lost.

It is to be sincerely hoped that every member of

the National Committee, and every member of the State Commissions, will do his duty with all the ability and energy at his command.

It is to be sincerely hoped that every member of the National Committee and every member of the State Commissions, will do his duty with all the ability and energy at his command.

THE CALIFORNIA COMMISSION.

The California State Commission held a meeting at Los Angeles in December. This body consists of Eli H. Murray, W. S. Green, C. C. Wright, L. M. Holt and J. A. Pirtle and ranks among the strongest in the list. A comprehensive plan of work was mapped out and is now being vigorously pushed by means of circulars and correspondence. The object is to obtain an expression from the largest possible number of citizens as to needed legislation and also to collect data showing the existing conditions. As a means to this end circulars have been issued by chairman Murray, a portion of which follows:

To facilitate this work the State has been divided into five districts, and each Commissioner has undertaken to compile the desired information in one district.

The first district includes the counties of San Diego, Riverside and Orange, and the work has been assigned to the Chairman of the Commission.

The second district consists of San Bernardino, Inyo, Mono and Alpine counties, and the work has been assigned to L. M. Holt, of Los Angeles.

The third district consists of Los Angeles, Ventura, Santa Barbara, San Luis Obispo, Monterey, San Benito, Santa Cruz, Santa Clara and San Mateo counties, and the work has been assigned to J. A. Pirtle of Los Angeles.

The fourth district consists of San Joaquin Valley and all that portion of the State south of San Francisco bay and including the counties of San Joaquin and El Dorado, and the work has been assigned to Hon. C. C. Wright of Modesto.

The fifth district consists of the Sacramento Valley and the remaining portions of Northern California and the work has been assigned to Hon. Will S. Green of Colusa.

Frank Robbins, of San Diego, was elected secretary of the commission.

THE COLORADO COMMISSION.

Committeeman Rocho is to be congratulated on the character of the commission he has selected for the great State of Colorado. It consists of L. J. Carpenter, Platt Rogers, J. Sire Greene and W. S. Carpenter. It would be difficult to improve on these names. Prof. Carpenter is the head of the department of irrigation engineering in the State Agricultural College at Fort Collins and a man of large ability and experience. He enjoys a national reputation among the friends of irrigation. Platt Rogers, ex-mayor of Denver, is probably the ablest irrigation lawyer in Colorado. J. Sire Greene is the former State engineer and made a great record in that office. He stands at the top of his profession. W. S. Carpenter lives at Cortez and is a very good representative of his section. Wonderful results are to be confidently anticipated from the work of the Colorado Commission.

NEW MEXICO AND MONTANA.

Committeeman Downing, of New Mexico, has named his commission, as follows: Frank S. Coolidge of Ohio, C. B. Eddy of Eddy, O. H. Hadley of Watrous, W. S. Hopewell of Hillsborough.

Committeeman Burton, of Montana, has named the following gentlemen for his commission: A. C. Botkin of Helena, Paris Gibson of Great Falls, W. H. Sutherlin of White Sulphur Springs, W. A. Clark of Butte.

Both of these commissions are full of good timber. C. B. Eddy, of New Mexico, is the head of the large enterprise in the Pecos Valley. Col. Botkin, of Helena, is a lawyer of great ability and the author of the memorial to congress, prepared under the instructions of the Salt Lake convention. W. A. Clark, of Butte, was for two years Montana's member of the National Executive Committee. He is one of the foremost men of his State.

PROFESSOR BOGGS RESIGNS.

THE AGE regrets to announce the resignation of Professor Edward M. Boggs, as vice chairman of the National Committee, and member for Arizona. He assigns as a reason the fact that his work as a member of the faculty of the University of Arizona, in connection with private cases, will absorb all his time. The resignation is a real loss to the work. Ex-Governor R. C. Powers, of Phoenix, is suggested as a man who would vigorously represent the important "State of Arizona."

HURRY UP THE COMMISSIONS.

Beside Arizona, commissions remain to be appointed for Kansas, Texas, Utah and Washington up to this writing. Irrigation is a comparatively new interest in Texas, and in Washington Dr. N. G.

Blalock has just had notice of his appointment. In Kansas the State Association is covering the field so thoroughly as to render less important the immediate choice of the commission. In Utah, however, the delay is deplorable. That territory has an enormous interest in the irrigation policies that will be adopted, and its long and successful experience renders it particularly able to enlighten the next Congress through the report of its commission. Governor Thomas is capable of selecting a very able commission and his action is awaited with the utmost interest.

THE NEBRASKA CONVENTION.

The irrigation convention held at North Platte, Neb., Dec. 19 and 20, was attended by about 400 delegates, representing the States from the Missouri river to the Wyoming line. Dr. S. D. Mercer, of Omaha, a gentleman of such prominence in political and financial circles as to render his attendance a significant evidence of the extent of public interest in the subject, was elected chairman.

The committee on organization, R. B. Howell, of Omaha, chairman, reported in favor of a permanent association being formed to cooperate with those of other States, to meet in December of each year, the officers of which for the ensuing year shall be: I. A. Fort, Lincoln county, president; J. G. P. Hildebrand, Lancaster county, secretary; P. Montensen, Valley county, treasurer; and an executive committee, consisting of the president, Martin Gering of Scott's Bluff, R. B. Howell of Douglas, D. Zimmerman of Dundy, D. H. Cronin of Holt, E. M. Seales of Keith, together with a vice-president from each county. This report was unanimously adopted.

Among the prominent persons present were: Governor Crounse, E. R. Moses, president, and J. L. Bristow, secretary of the Kansas State Irrigation Association; Martin Mohler, secretary of the Kansas State Board of Agriculture; Judge J. S. Emery, Topeka, lecturer for the National Irrigation Association, and Donald W. Campbell, the well-known irrigation engineering authority of Colorado.

Judge Emery, D. W. Campbell and J. L. Bristow delivered addresses, all of which were practical, enthusiastic and yet fair statements of the problems involved. Government aid was favored for surveying and laying out districts, which shall properly combine water sheds and basins, give an intelligent idea of available water on and under the ground, and in general demonstrate the practicability of irrigation. Also aid for the establishment of experimental stations was advocated, storm water storage, pumping water by electricity or wind power, small farms, collection of farmers of irrigation districts into villages, and the advantages of the whole system of irrigation were eloquently set forth in these addresses.

PULSE OF THE IRRIGATION INDUSTRY.

THE BEAR VALLEY SITUATION.

IN a peculiar sense the affairs of the great Bear Valley Irrigation Company, of Redlands, Cal., are just now the concern of the financial side of the irrigation world. This company had been paying dividends of eight per cent. upon \$500,000 of preferred, (another \$500,000 in the treasury unsold), and of fifteen per cent. upon \$3,000,000 of common stock. Very naturally it was generally quoted as a conclusive argument in favor of investment in irrigation securities, in many prospectuses issued in the interest of other enterprises. Under these circumstances the failure of the Bear Valley Company produced widespread consternation, and the argument it formerly furnished to the promoters of irrigation enterprise suddenly became an argument of a different kind. Nevertheless the fact remains that Bear Valley is a type of good irrigation projects and that it ought even yet to illustrate the value of irrigation as a safe form of investment when in the hands of conservative men.

THE COMPANY'S CONDITION.

The Bear Valley Irrigation Company has a bonded and floating debt of a little less than \$1,000,000. There will be required to complete its plant and to fulfill its present water contracts about \$1,000,000 more, according to Chief Engineer Wm. Ham. Hall. The property would easily stand a bond of \$2,000,000, and such a loan should be readily floated at six per cent. It is to be remembered that between \$2,000,000 and \$3,000,000 of actual money has been invested in its capital stock by eastern and foreign shareholders. If from proceeds of bond sales the indebtedness were paid and the plant completed, the company would then have an annual income as follows:

From "Class A" water certificates.....	\$ 7,200.00
From sundry other contracts.....	1,800.00
From 100,000 "Class B" certificates, (@ \$2.78 each) ..	278,000.00
	<u>\$287,000.00</u>

Its annual expenses would be about as follows:

For maintenance.....	\$ 50,000.00
Interest on bonds.....	120,000.00
Dividend on preferred stock.....	40,000.00
	<u>\$210,000.00</u>

This would leave a balance of \$77,000, but it is not to this source alone that holders of the common stock may look for dividends and bondholders for the creation of a sinking fund. The completed plant will furnish water, according to Engineer Hall's estimate, for 100,000 "Class B" certificates, of which 25,000 remain to be sold. They are in demand and will

probably sell readily for \$50 each. The company has also \$500,000 of preferred stock, \$500,000 of the Alessandro Town Company stock (generally believed to be worth its face) and 10,000 acres of very valuable land. A statement of these resources would look as follows:

25,000 "Class B" water rights at \$50.....	\$1,250,000.00
Preferred stock in treasury.....	500,000.00
Alessandro Town Co.....	500,000.00
Irrigation District Bonds.....	400,000.00
10,000 acres of land at \$100 net.....	1,000,000.00
Total ..	<u>\$3,650,000.00</u>

If these assets be reduced to cash the \$2,000,000 bonds would be retired and a surplus of \$1,650,000 remain for investment, yielding an annual income of \$99,000 at 6 per cent. Under these conditions the statement of income and expenditures would stand as follows:

EXPENSES.

For maintenance.....	\$ 50,000.00
8 per cent. dividend on \$1,000,000 preferred.....	80,000.00
6 per cent. on \$3,000,000 common.....	180,000.00
	<u>\$310,000.00</u>

INCOME.

From water rentals.....	\$287,000.00
6 per cent. on \$1,650,000 surplus	99,000.00
	<u>\$386,000.00</u>

Balance to surplus, \$96,000

If water is available for another issue of certificates the dividend on common stock could probably be carried to eight or ten per cent. Can the above results be realized? Undoubtedly, with good management. There would be required (1) a good local manager who understands the practical side of the irrigation industry; (2) a trustworthy engineer of economical tendencies; (3) a competent financial agent; (4) a live colonization promoter who could settle the lands with actual residents and planters. The first two places are easy to fill. As for a financial agent, the peer of Chas. W. Greene in this department has not yet been discovered. As for the colonization manager, Frank E. Brown is showing the whole world how to do it just at this time with his Lake View Colony.

MR. GREENE TO MR. BROWN.

THE AGE has not entered into the history of the company and the causes of its present embarrassment any further than it is necessary to go in order to prove that the unfortunate situation is no reflection on the intrinsic merits of irrigation securities. But in the last number the open letter of Mr. Brown was published. It contained a reflection upon Mr. Greene's management as the immediate cause of the failure. To this Mr. Greene replies as follows:

EDDY, NEW MEXICO, Jan. 5, 1894.

To the Editor of The Irrigation Age:

In your January number, you refer to the embarrassments of the Bear Valley Irrigation Company. You say that *THE AGE* has studiously refrained from any discussion of the affairs of the company up to that time, but that now the embarrassment has reached a point where a receiver could no longer be avoided, and it seems necessary to allude briefly to the personal friction between the present and the former manager—between Mr. Greene and Mr. Frank E. Brown.

There has been a studious effort ever since I assumed the Presidency of the company to make it appear that the reason for my doing so was owing to personal misunderstandings. This is not the case in any sense of the word. I had no thought of taking the presidency and management of the company until I found that through its mismanagement it was liable to fail in the performance of its obligations to the shareholders, whom I had induced to invest in its securities upon the representations made to me by Mr. Brown and his associate directors. Had there been no previous mismanagement of the company I should never have been its president. My circular of October 2d was published because at the instance of parties acting for, or in the interest of Mr. Brown and his new schemes, an attack had been made upon the company and its present management, and I simply undertook to make explanations as to that attack, showing at the time the exact condition in which the company had been placed. You say, "Mr. Brown has made no reply to the remarkable indictment." He could make no reply, at least not in the sense of a denial, because every statement made therein was susceptible of proof.

The card "To the Public" by Mr. Brown is a most remarkable document. For assurance I never saw its equal. A man who had so mismanaged the affairs of the company as to call down upon him the condemnation of every one of his associates, making it necessary, as they expressed it, that he should be "forced or kicked out of the company", proposes to pose as the saviour of the company, to save it from the effects of his own mismanagement, or worse. His "forbearance in refraining from the step until now to avoid a controversy which might be injurious to the interests of the company" is particularly good, when every word that has been said and every word that has been published, has been published because of what he has done and said personally. As I have shown in the published statements to shareholders, from the time he sold out his stock and left the directory, months ago, he has been persistently attacking its credit. He has gone so far in fact as to state that the water supply of the company was not properly secured, although he himself had been responsible for securing it. He has offered to sell one-half of the stock in the company when he had no right to sell anything, and generally doing all that was in his power with the effect of causing the disaster which has now come, in spite of all the efforts which the other directors and myself have been able to exert. He "regrets very keenly the disaster"—which he himself produced. I should think he would. A man, who can mismanage the funds entrusted to him as he has, who can be so utterly lacking of consideration, not only for the welfare of individual investors, who have trusted in his good faith and honesty, but for all similar enterprises, which are dependent upon the investing public to furnish funds for their construction, ought to feel regret, by this time, for what he has done, and he ought to show his penitence in some other form than in such a card as this. He says he has been assailed because he foresaw and had the courage to point out what must be the inevitable consequences of "the policy pursued by the short-sighted and wrong-headed management." The inevitable consequences, to which he refers, are the direct result of his short-sighted and wrong-headed management, if it should not be expressed in stronger language even than this.

The Bear Valley enterprise is undoubtedly one of the grandest irrigation works in this, or any country, and it is a shame, a cruel shame, that such a disaster should be brought upon it for such a reason and with such deplorable effect.

It is noticeable that Mr. Brown calls upon a comparative stran-

ger to certify as to his good character, and that certificate is made after an examination extending over perhaps ten days. Mr. Cave came to this country in the employ of Mr. Brown as a solicitor, and made the trip at his expense and was his guest for the time being. It strikes me that it would have been quite as appropriate for Mr. Brown to have called upon his associates for a certificate of this kind—but it might have been differently expressed.

As you say, my responsibility originally was simply that of a financial agent. In that respect I was certainly successful, for I furnished nearly two millions and a half of money to the enterprise, which, if it had been properly managed during Mr. Brown's régime, would not have been in the condition that it is today. It was not for lack of funds, (which I furnished to them,) but it was through misuse of the funds and mismanagement of the enterprise that the disaster has come. It is a misfortune in every sense of the word—a misfortune for which the parties themselves should be held to the strictest accountability; and a misfortune to the irrigation industry, which will suffer more by such a blow to the credit of a leading company than any one can tell. For my own part, I court any investigation which *THE AGE* may choose to make, and I certainly have no reason, personally, to fear any fair criticism.

Very truly yours,

CHAS. W. GREENE.

This is positively the last appearance of the personal controversy in the pages of *THE AGE*, but in "closing the incident" it is only just to state Mr. Brown's position as his friends understand it.

MR. BROWN AND BEAR VALLEY.

Frank E. Brown created the Bear Valley system more than any other man. It originated in his brain and it was carried to triumph very largely by his indomitable pluck and undefeatable energy. When it had reached a stage where its physical success was assured, while its complete development demanded the use of much more money, Mr. Greene assumed the duties of financial agent. Mr. Brown claims that Mr. Greene from that time on directed its financial policy and that he is responsible for the result. Mr. Brown admits that mistakes were made by himself and his associate directors, but does not admit for a moment that any wrongful act was done. He has evaded no responsibility, moral or financial. It is true that he disposed of his holdings in Bear Valley stock, but when he had paid his honest debts with the proceeds he invested the balance under the Bear Valley system and became the largest patron of Bear Valley water. Mr. Greene removed his profits further East. From the day that the company went into the hands of a receiver Mr. Brown has been trying to assist in bringing about a plan of reorganization that would protect the irrigation districts and stockholders alike. He has devoted very little of his time to bewailing the past or assailing his critics. And he stands with his face to the sunrise, planning and working, and not without encouraging results, for the good of Southern California. It may be added that in personal conversation he speaks handsomely of Mr. Greene's ability as a promoter, and expresses the hope that he may be blessed with abundant success hereafter.

REORGANIZATION.

The Bear Valley Company will be reorganized in the interests of its stockholders, or it will fall into the eager and capacious mouth of a party of wreckers. The air is full of rumors about the latter possibility, but it is to be hoped that this additional calamity will be spared the irrigation industry. The foreign stockholders have committed their interests to James Gardner Clark, and the New England stockholders are now conferring with that gentleman. The outcome is awaited with deep interest by the entire world of irrigation.

AN INTERESTING PROJECT.

An interesting work of reclamation is now under way on the Mojave plains, or desert, along the Mojave river in California. It is north of the mountains in San Bernardino county. The diversion of the water will be accomplished by a novel plan. It will be done, we are informed, by means of a box-flume extending diagonally across the river bed for a distance of 1,600 feet; the bottom of this box-flume is fourteen feet below the surface. The bed of the river at this point consists of gravel and sand—largely gravel—and this is underlaid with a clay formation, which is from 15 to 28 feet below the surface—an average of about 25 feet. This entire body of gravel and sand, 25 feet thick by 1,600 feet wide, is full of water, and as the river bed has a fall of 19 feet to the mile, and as the river bed is always full of water with a stream flowing on the surface at all seasons of the year, and as the water shed above this point consists of about 400,000 acres of mountains, with an elevation of from 5,000 to 9,000 feet and a further area of foothill territory, covering about 800,000 acres, the underflow of the river at this point must be very great. This is evidenced also by the fact that the Mojave river at a point 40 miles above these headworks has a surface flow in mid-summer of about 10,000 to 12,000 inches. To secure this entire flow of water a sheet pile dam is to be put down extending across the river just below the box-flume and reaching down to the clay formation. This will shut off the underflow and force the entire current into the box-flume and from thence into the canal.

Water power, railroads to the neighboring iron mines, town sites and other agencies of development are talked of in connection with the project.

Work will soon be commenced at Saguache, Colo., on a storage reservoir for which the legislature appropriated \$30,000. The site selected covers an area of 169 acres. About two miles of main ditch will also be built.

IN WESTERN NEBRASKA.

THE AGE is indebted to A. B. Wood, editor of the *Gering Courier*, and George H. Lawrence, C. E., for the following carefully prepared statement of the amount of construction work done upon canals heading in Scott's Bluff county, Neb., during 1893. These canals are taken from the North Platte river. The figures do not purport to be exact in every case, but are approximately correct:

Castle Rock Irrigation Canal and Water Power Co., completing ditch.....	\$ 7,000.00
Lawrence Canal and Reservoir System.....	1,625.00
Mitchell Irrigation and Canal Co.....	3,000.00
Ramshorn Irrigating Ditch, new.....	5,000.00
Enterprise Ditch Co., enlarging and new headgate.....	4,320.00
Winter Creek Canal, enlarging and new headgate.....	3,068.00
Central Irrigating Co., new headgate and enlargement..	2,000.00
Minatare Canal and Irrigating Co., enlargement.....	2,000.00
Farmer's Canal Company, headgate and construction, new.....	10,000.00
Chimney Rock Canal Co., extension.....	1,000.00
Nine Mile Canal and Irrigation Co., new work construction.....	1,000.00
Alliance Irrigation Company, new work construction....	3,000.00

The year has been one of great progress, putting each of the old canals on a permanent basis by the building of new headgates, and enlarging to the necessary capacity. Aside from this, the new construction has been very gratifying considering the stringency of the times. Two new canals have been begun and gotten well along. Viewed from whatever point, the total of \$43,013 expended this year is to say the least reassuring.

A BIG NEBRASKA COMPANY.

Articles of incorporation of the Midland Irrigating and Land Company have been filed in Douglas county, Neb. The incorporators are well-known business men of Omaha, and include Isaac Coe, Levi Carter, John Brant, Nathan Shelton, Frank Murphy, J. E. Markel, and ex-Senator Alvin Saunders. The capital stock is fixed at \$1,250,000.

IRRIGATION NEWS.

The board of commissioners of Weld county, Colo., has decided that several canals are liable for taxation only to the extent of the "unsold beneficial interest therein," and has readjusted the assessment of several years past.

The Rio Grande Irrigation Company has been incorporated by E. J. Reed, B. T. McKeys and G. A. Anderson, of Deming; capital stock, \$1,000,000. The charter calls for a canal line beginning on the Rio Grande river at White Rock cañon, west of Santa Fé, New Mexico, and skirting the foothills of the valley on the east side of the river and running south 150 miles. This is the second charter that has been taken out covering practically the same territory, and a conflict over the right of way is expected to arise.

TALKS WITH PRACTICAL IRRIGATORS.

SUGGESTIONS IN WHEAT CULTURE.

By W. C. FITZSIMMONS.

AMERICAN farmers annually plant nearly forty million acres to wheat and reap a pitiful harvest of about thirteen bushels per acre. Three hundred years ago the English farmers were realizing about the same yield per acre, but at this time they confidently count on a yield of double that amount. The acre out-turn in the United States is but little, if any, in advance of that in India, where we can scarcely believe the soil of the twenty-six million acres devoted to wheat is more fertile than our own. The climatic conditions obtaining in the Punjab are certainly not better adapted to cereal production than those of a vast region devoted to the crop in this country. Nor can we for a moment suppose that the general intelligence of the Indian wheat farmers is as high as that of Americans engaged in the same occupation. Though wheat has been grown in India from time immemorial, it is only in recent years and under irrigation that she has become so formidable a competitor to ourselves in the wheat markets of the world. But in spite of the lower intelligence of the Oriental wheat farmer, and in spite of the fact that his crop is often grown upon lands that were thousands of years old in cultivation at the time when Columbus sailed westward across the unknown sea, still the Indian wheat grower produces as great a yield per acre as the American whose virgin lands have been, in comparison, scarcely touched. There must be some reason for this, then, other than superior general intelligence or greater fertility of soil in the Orient. The irrigation of wheat fields to some extent in India is a main factor in the successful competition with the superior American intelligence and superior American appliances for gathering the harvest and transporting it to a market. This, coupled with the low labor cost must, so long as present conditions obtain, operate to the continued detriment of American wheat growers in the struggle with those of India and Egypt. We must improve our method and curtail the waste of labor, manure and money in the production of a half crop of wheat upon a double area of land. Except in limited sections, it is certainly true that the average American farmer does not practice the wisest economy or proceed upon the most approved lines in the production of wheat. Our methods, as practiced in the greater wheat-growing states, are primitive in the extreme and wholly incapable of defense on the plane of scientific husbandry. The English, Scotch and Irish wheat growers are far in advance of us in their methods of preparing the

land as well as in the care taken to maintain or increase its fertility by a judicious system of fertilization and cropping. Thousands of American wheat farmers never think of fertilizing their lands, and even burn the straw and stubble of one crop in preparation for another. Success demands that the land shall be thoroughly and scientifically prepared, and the seed to be sown must be carefully selected by close screening and assortment, to the end that only fully developed grains shall be sown. Then, too, long experience in some places has impressed upon certain of the most intelligent wheat farmers the fact that a lesser quantity of seed sown upon a properly prepared seed bed will give better returns than a much larger quantity of seed sown upon land not scientifically fitted for its reception. In a word, most American wheat growers plant too much seed, and do not properly prepare their ground. A very common practice throughout a large part of the cereal areas of the United States is to sow a bushel and a half of seed per acre. In at least ninety per cent. of cases this is entirely too much. In some large sections five pecks is the standard amount for sowing an acre of land. This, also, is too great a quantity, if the conditions leading to the best success in wheat growing are nearly fulfilled.

Careful and prolonged experiment has shown that under easily secured conditions wheat plants will stool into ten or twelve culms, each of which will carry twenty to sixty grains. This would indicate a yield several times as great as that ordinarily obtained and even greater than that ever reached on a large scale. From this we must infer that a great part of the seed usually planted does not germinate at all, or fails to mature a grain-bearing plant. With a possible yield of several hundred fold, it is scarcely creditable to American farmers that they go along year after year contentedly reaping a ten fold or twelve fold crop of seventy-five cent wheat. In some sections of the northwest, certain advanced wheat growers have reduced the amount of seed sown, and have been surprised at the result. In fact, it has been shown that on properly prepared ground a half bushel of the best seed wheat brings a better average yield than two or three times as much seed sown in the ordinary manner.

The writer once knew a progressive farmer in Michigan who made experiments and profited by them. From the usual six pecks of seed wheat per acre, he gradually cut down the amount each year, noting carefully the effects of his slight reduction. He found that by putting his ground in condition to receive and bring forth a large proportion of the seed

planted, three pecks would uniformly bring a larger harvest than double the quantity sown. He also believed that if the grains were planted at regular intervals like corn hills, the yield would be very much greater still. In fact, experiment with small plats has shown this position to have been well taken.

While it is certainly not desirable that American farmers, under present conditions, should increase the aggregate yield of wheat, it is desirable and should be in every way advantageous, that the out-turn per acre be very greatly increased. Better let one-half the land lie fallow than to send away across the sea as now, its vital elements in an unprofitable crop. Ship loads of potash, nitrogen, lime and other valuable ingredients each year leave American soil to find their way to the sewers of London, which should remain at home as an insurance policy for the future welfare of our own people.

Were American farms managed with the same business sagacity which characterizes American factories, overproduction of a given article would immediately result in a curtailment proportioned to the legitimate demand. But it has been a tradition of the farmer in the United States that he should lead an independent life, and that all coöperation or combination cometh of evil. Happily, however, progress is making along this line, and the grange, the alliance and the farmers' club are having an educational effect already felt in nearly all parts of the country. In the irrigable sections, where small farms may be and are profitably tilled, more compact communities are possible, and most of the benefits to be attained by closer association are easily secured.

It can scarcely be believed that American farmers will continue much longer to go blindly along as did their ancestors, producing crops whose only justification is time-honored usage, and paying little heed to the world's demands.

To say nothing of any attempts by the American farmer to seek his own welfare through the channels of legislation, he has it within his power to adjust his staple productions to the conditions which a careful study of crop statistics and methods in other countries show must be accepted or met in the American and foreign markets. A hopeful sign of the new agriculture which must soon be learned by the western farmers especially, is the organization of clubs having for their object the gaining of correct information of the world's wheat crops each year, and from the data thus obtained endeavor to influence the growing of crops to correspond with probable demands. Let such associations become common among farmers in all parts of the country, let the necessary steps be taken to learn fully each year the statistics of the world's production and consumption of the various

food crops, and the soil tiller may then adjust his acreages of the different crops in some measure to the needs and conditions of those who consume them.

One of the functions of THE IRRIGATION AGE will be to point out from time to time to American farmers that neither their own nor their country's welfare is greatly subserved by producing enormous crops of wheat to sell in the markets of Liverpool, London and Glasgow. It sounds well to say that we export a hundred million bushels of wheat, but what do we make by it? We sell our wheat in Liverpool in competition with Oriental ryots and fellateen and the grain that represents the lowest possible cost of production and transportation fixes the price of all, and we are absolutely helpless against this competition.

The Harvard graduate who raises wheat in Minnesota, Kansas or California must scramble with Oriental barbarians in the wheat marts of Great Britain; and the barbarian always has this advantage in the conflict—he can produce his goods at a much less cost than the American, and can therefore undersell him.

Were it possible for THE AGE to reach the ear of every American farmer, whether in the irrigable regions or not, it would appeal to him to study the crop reports as he would his Bible; to study, and figure and reflect. It would appeal to every wheat grower to cut down his acreage at least one-half, and to bestow a corresponding increase of labor and attention upon the remainder. It would urge him to besiege the Department of Agriculture for its monthly crop reports and to utilize that agency to the utmost limit for the acquisition of such information as it may and does offer to every farmer without money and without cost.

ADVISORY FUNCTIONS OF THE DEPARTMENT.

It would appear, too, that the Department might very properly undertake advisory functions to a certain degree at least; and when conditions showed an overproduction in a certain line, suggest a scaling down of subsequent plantings in such manner as to restore the equilibrium between production and living prices. The farmer should remember that the conditions of production, transportation and marketing have undergone radical changes within the past few years, and these changes require a readjustment of means to ends by the agriculturists themselves. No branch of agriculture, however, is more in need of reformation than that which results each year in an enormous overproduction of wheat to be hawked in the markets of the world at any price which the foreign speculator may be good enough to offer.

Our statistics of production for the past fifteen years show that the potato crop has been more than three times as remunerative per acre, gross, as the wheat crop, and yet for the past two years thousands of farm-

ers have been consuming potatoes grown in Scotland or Germany, and paying for them at the rate of nearly two bushels of wheat for one of potatoes. If all these conditions were irremediable, the outlook for American agriculture would not be the most hopeful, but *THE AGE* believes they may be easily remedied, and only require to that end that American farmers shall conduct their business on the same business-like plane that characterizes the transactions of the merchant, the manufacturer or the professional man; and *THE AGE* is in the field to bear a hand in helping him to attain these ends.

CAN WE GROW COFFEE IN THE UNITED STATES?

A number of horticultural writers allege the possibility of producing coffee in commercial quantities in some parts of the United States. It is questionable, however, whether the climatic conditions obtaining in any part of this country are such as to give reasonable ground for the hope of ultimate success in coffee culture. The only sections of country of probable utility in this connection are found along the Pacific coast in Southern California and a narrow belt in southern Arizona, with the possible addition of a limited area in the interior desert region between San Bernardino, California, and Yuma, Arizona, in the neighborhood of Indio or Salton, along the line of the Southern Pacific railroad. The coffee tree will not endure severe frosts at any stage of its growth, nor hot sunshine during the first two or three years after planting. "Frostless belts," so-called, are quite numerous in the United States, if we may believe the advertisements of the various land companies. As a matter of fact, however, the frostless areas of the United States are exceedingly limited. The southern coast of Florida may show some localities exempt from frost, though the low coast lands in such regions are not regarded, in coffee producing countries at least, as suitable for the growth of that berry.

But it is not wholly a question of climate. Were other conditions favorable, it is to be doubted whether the cost of labor in the United States would permit of coffee culture in competition with Brazil, Central America, Mexico and other coffee-yielding countries. While much of the work of preparation for market is done by machinery, yet the amount of hand labor involved in picking the berries, assorting and other operations is so great that at present prices the cost would be wholly prohibitory of any profit to the grower. It is so very desirable, however, that we should produce our own supply of coffee, that experiments should be continued in all sections of the country offering reasonable hope of success. It is the largest item in our long list of annual imports, and last year reached nearly one hundred and forty million dollars. It is thus seen what an enormous

industry might be developed were conditions favorable. The Arizona and California experiment stations might well undertake a line of observations in this connection with a view to determine with some certainty whether or not the coffee tree may be made to thrive commercially in the United States.

FARM NOTES.

As long ago as 1890 the butter yield of the United States was about 600,000 tons. Of this amount it is estimated that 300,000,000 pounds were unfit for food and were utilized as grease for machinery or other purposes. Good butter always commands a good price and farmers through the irrigated regions may easily produce alfalfa, from which the best results may be expected as a butter producer. The alfalfa field should have a place on every irrigated farm.

ADVANCED dairymen find that a herd of say sixty cows that will yield 300 pounds of butter each that will sell for \$90, and which cost about \$3 per month each to keep, will prove more profitable than a herd of 200 cows producing 200 pounds each of 20 cent butter and which cost \$30 per year each. It will always pay best to keep the best cows and take the utmost care in their food and shelter.

WHATEVER may be said of the orange, the lemon, the fig, the prune or the peach, the fact remains that the apple has thus far been found the most useful American fruit. The consumption of apples is increasing in this country, and the production of good winter varieties is not yet up to the demand at reasonable prices. This year the apple crop is a very short one, and prices in many places are beyond the ability of the masses to pay, hence they cannot eat apples.

A LATE report from the Riverside (Cal.) Water Company shows that the canals, ditches and pipe lines which have created that wonderful oasis in the desert, are now valued at more than \$1,000,000. The principal products of Riverside are oranges, lemons and raisins, but there is abundant opportunity to produce many other fruits, and a number of manufacturing plants should thrive in this remarkable colonial settlement.

IN planting orchards of any kind the utmost care should be exercised in the selection of the trees as well as the site of the orchard. It should be remembered that an orchard is or should be a fixture. Mistakes made in its establishment cannot easily be corrected. Expense saved in buying inferior trees is money wasted, and planting trees on poor land or in exposed places should be avoided. The very best land for the purpose should be occupied by the orchard. Other things being equal a gentle slope, insuring perfect drainage, is the best site for an orchard. A steep hillside may often be found better than a flat tract, especially if not well drained.

HORTICULTURE BY IRRIGATION.

PROGRESS IN HORTICULTURE.

BY W. C. FITZSIMMONS.

NO other rural pursuits, perhaps, have made so rapid advances in the United States during the last half century as the cultivation of fruits and flowers. It is with the progress of fruit production and consumption, however, that this article will be concerned. Eminent dietary authority asserts that, given a certain environment, the quality and degree of civilization of any people will be governed largely by the food consumed. A Daniel Webster could scarcely be evolved from a line of ancestry consuming only whale blubber, nor could a Jean Jacques Rousseau come from a succession of pork eaters. Given a variety of wholesome food from which to choose freely, that people which seeks a combination of grain, fruits and meats as its staple diet may be taken to best represent the most staple and the most progressive development along the line of the higher civilization and culture. If we are to judge the American people by the food they eat—and such judgment is certainly not an unfair one—we must conclude that we rank high among civilized people; for probably no nation on the earth is so great a consumer of various food products as our own. Nor does this statement apply merely to the aggregate consumption by the people as a whole, but to individual consumption as well. We are certainly not a nation of wine bibbers, and in respect to the drinking of wine bear no comparison whatever with the people of France, Italy, Spain and many other countries. But taken as food consumers we hold very high rank, and in the general average, head the entire list. While we consume a trifle less wheat per capita than the French, we use vastly more corn and oats, as well as meats of various kinds. We do not equal the British in our liking for tea, but as coffee drinkers we lead the world. Meat forms a part of the daily diet of almost every American family, and fresh fruits or those in a cured or preserved state, are becoming a daily requirement of American life. In the matter of fruit consumption the luxuries of yesterday soon become the commonplaces of to-day and the necessities of tomorrow. Perhaps no better illustration of these facts can be given than to cite a short chapter in the history of early grape growing in the state of New York.

About forty-five years ago an ambitious grape grower in the Kenka region of the state of New York sent to market in the metropolis of that state a consignment of one hundred pounds of grapes. The fruit reached its destination in good order and the

consignee, a "hustler" in his day and generation, managed to place the entire lot at figures quite satisfactory to himself and his client. The dealer urged the grower to increase his consignments the following year and promised extraordinary diligence in disposing of his crop. The happy grower, seeing visions of wealth in his business, sent his entire crop of three hundred pounds to the city the following year; but unhappily, so heavy a consignment broke the market completely, and the commission dealer was obliged to report his failure to place the shipment before a considerable part of it had spoiled on his hands.

The market that reeled, and actually broke down under the pressure of 300 pounds of grapes at that time, to-day readily absorbs more than thirty thousand tons of the same variety of fruit. At that time probably not one American in a hundred had ever tasted a cultivated grape, and it was years thereafter before even that small proportion of our people had seen a banana or tasted a mango or pineapple. But pineapples are now grown by the hundred thousand in Florida, and more than seven hundred and fifty million lemons were consumed in the United States in 1893. Besides a crop of nearly four million boxes of oranges grown in Florida for the crop of 1892-3, and about two million boxes produced in California, there were imported over one million boxes of foreign oranges valued at \$1,695,455. The value of lemons imported for the fiscal year ending with June last was \$4,994,342.

Not many years ago a New York dealer imported a few bananas, but found the fruit not to the taste of the people, and was unable to sell a job lot of twelve bunches. Finally the goods spoiled in his shop, and he became disgusted with the foreign fruit trade. For the year ending June 30th last, there were imported somewhat over twelve million bunches of bananas at a cost of \$5,361,187.

But it is by no means from the large consumption of foreign fruits alone that we are to measure the absorptive capacity of the American markets for fruit products of various kinds. The entire imports of all varieties of fruit cut but a small figure in the aggregate consumption. American orchards and vine yards are fast multiplying in nearly all parts of the Union, and their rapidly increasing output is annually being consumed by the American public. For some years overproduction of fruit of nearly all kinds grown in this country has been proved by many, and the ratio of increase in orchard areas from year to year has seemed to give force to the suggestion.

If we reflect, however, that men still comparatively

young, well remember when it was difficult to sell peaches, for example, at 25 cents per bushel in central New York, and when apples were often sold at fifty cents to a dollar per wagon-load in some districts, we may take courage from the knowledge that although the product is now immeasurably greater than it was then, the prices are also far higher at the present day.

IMPORTANCE OF FRUIT CULTURE.

From a side issue on the farm of twenty or thirty years ago, fruit production has come to be recognized as a leading rural pursuit in very many parts of the country, covering wide areas of territory. No other form of agricultural life compares with that of fruit production in point of scientific requirement or in the elevating and educational tendencies of the pursuit itself. In fact, the successful pursuit of horticulture requires a high degree of intelligence, and no inconsiderable amount of culture along scientific lines. Indeed, it may almost be termed a profession, so exacting are its requirements when the best results are to be alone accepted.

These facts, if fully considered, should give comfort to those who fear the early overstocking of all markets with fruit products. Not all who engage in the business will succeed. Many failures must occur as the result of incompetency or other conditions which time and experience may or may not overcome. Certain limitations fixed by nature, for example, may never be exceeded. Oranges may not be produced in Michigan nor apples in Florida. The "peach belt" must be narrowed down to those sections of the country wherein excessive cold in winter does not destroy the trees, nor late spring frosts blast the buds or blossoms. In all sections the utmost vigilance must be exercised in protecting orchards of all kinds from the ravages of insect pests. Prunes, apricots, olives and figs cannot pass the barriers which nature has erected, and other fruits and nuts can be produced only upon limited areas. From all this it must follow that intelligent adaptation of means to ends is a *sine qua non* to successful fruit culture in the United States, and especially in new and undeveloped regions. The commercial orchardist is a comparatively new factor in our industrial system, but from this time forward, upon him must mainly rest the burden of supplying the American people with that quantity and variety of fruits which their awakened and more refined gastronomic sense will hereafter demand. Old methods must give way to the more advanced ideas of the modern specialist, and the slipshod ways of a few decades ago cannot be expected to win in the horticultural battle of the present and the future. It is not the purpose of the present article to go into details of varieties, cultivation, fertilization and marketing; but merely to call

earnest attention to the vast and far-reaching importance of the subject of fruit-growing in general. In future issues of THE AGE other phases of the subject will be treated, and the adaptability of certain varieties of fruit trees and vines to conditions of climate, soil and cultivation within the wide domain of the arid zone will be considered in due course. It may be here stated that in the peopling of the irrigable areas of the newer west, horticulture is almost certain to be a corner-stone of the edifice of that higher and mightier civilization that is sure to result from a comprehensive, just and enlightened policy on the part of the people of the older sections and of Congress towards those regions which need but the revivifying touch of water upon their fertile though arid soils to transform the desert into a blooming garden of the Hesperides. Small but intensely tilled holdings will characterize the future developments of arid America. And while a mixed husbandry will no doubt predominate, as being more conducive to financial independence, except under extraordinary conditions, the production of some variety of fruit in commercial quantities will almost necessarily become a certainty growing out of the favorable conditions which may be artificially supplemented in the arid belt. It will be the pleasing duty of THE IRRIGATION AGE to aid to the utmost of its ability and to guide aright the home-builder who seeks the arid lands whereon to establish his fields, his gardens and his fruitful orchards.

IRRIGATION BY PUMPS IN CALIFORNIA.

Irrigation by means of pumping appliances has been resorted to with advantage in some cases even in California, where fuel is expensive. As a general proposition, irrigating water is distributed in that State by gravity, from reservoirs situated in the mountains or higher cañons of the foothills, whence issue streams which may be utilized by damming or otherwise by their perpetual flow for purposes of irrigation.

In the Santa Clara valley, California, the great prune center of the United States, irrigation of orchards is not generally resorted to. A considerable rainfall at opportune seasons has generally been accepted heretofore as affording sufficient moisture for purposes of successful prune culture.

During recent years, however, the rainfall has not proven sufficient in all cases, and some growers have resorted to irrigation devices of some kind. But it is not probable that ordinary farm crops would bear the expense of irrigation by means of pumps driven by steam power. Mr. Henry Booksin, of San Jose, lately gave his experience in irrigating his fruit orchard by means of pumping machinery. He found that his fuel cost at the rate of \$6.75 per cord for wood, but

that the nature of his products was such as to justify the operation and yield a good profit. He gave figures of the proceeds from his land as follows: "This year I received a check for \$25,000 for the fruit product of 80 acres, divided thus: From 29 acres of prunes, \$11,800; from 6 acres of cherries, \$3,200; and the remainder from 45 acres of assorted fruits."

This product of over \$300 per acre for the entire 80 acres was made possible only by the use of irrigating water, and must be regarded a good showing for a year of remarkably low prices. Peaches brought but one cent a pound in Mr. Booksin's orchards, and prunes and other fruits were but little higher in price; yet the water used at so great a cost enabled him to realize a large revenue from his land.

In a number of places systems of filling reservoirs by means of pumps driven by electrical force developed by water power in the streams from which the water is to be pumped are being instituted. Negotiations are now pending for the establishment of a plant as part of an irrigating system in Fresno county, wherein it is expected to develop some seven thousand horse-power of electrical force. A part of this is to be applied to raising water for irrigating purposes, and a part of it is for use by manufacturing establishments. As showing in a small way what may be in time expected from the development of electric force by falling water, it may be mentioned that the power derived from a Pelton wheel placed in a small stream in San Antonio cañon near Ontario, in Southern California, is carried to San Bernardino, 28 miles distant, and there used for street lighting with great satisfaction. A 1,200 horse-power plant of wheels is to be put into the Bear Valley water system for light and power purposes at Redlands, Riverside and other places nearly thirty miles away.

It is believed by capable engineers that there are many places in the mountain States where irrigation systems of considerable magnitude may be installed more cheaply by raising the water to reservoirs by power derived from the stream itself than by the damming of the water course itself. Pumping, as a means of securing irrigating water on an extensive scale, however, is not likely to be largely resorted to in the arid regions until special need thereof shall have been shown by experience, or in exceptional cases where a special product is to be grown at a price insuring comparative safety for such an investment. The purpose of citing these examples is merely to set forth the paramount and recognized advantages of irrigation. It certainly must be of the highest importance if fruit growers in the Pacific rain belt can afford to pump water for their orchards by steam at a cost of \$6.75 a cord for fuel. THE AGE will devote considerable attention to irrigation by pumping during the current year.

PRESERVING SOIL-MOISTURE.

In the regions which are practically rainless during the season for growing certain crops it becomes important to know if any system of cultivation can materially assist in retaining the natural moisture of the soil for use by the growing crop. The answer is decidedly in the affirmative. By careful and thorough cultivation whereby the surface soil is finely pulverized, the water naturally or otherwise in the soil is largely prevented from evaporation, no matter how hot the sun or how drying the wind. Evaporation from any soil takes place only as the water is brought to the surface by the forces of capillary attraction; and whenever the capillarity is broken up by shallow but thorough cultivation, evaporation must cease in a corresponding degree, since the soil-water fails to come to the surface of the ground. In fact, the well pulverized layer of earth at the surface serves as a mulch in retaining the moisture beneath it. This should obviously not be too deep, since the effect of continually stirring the soil would be to expose to the sun and air a greater surface and hence expedite evaporation. Shallow and frequent cultivation therefore, not allowing the formation of new capillary tubes by the gradual settling of the soil, is manifestly the remedy against injury of cultivable crops from the effects of long continued drouths. So well are these principles understood in some parts of the rainless belt that good crops of fruit and even corn are raised without a drop of rainfall or of irrigating water during the period of their growth. It should be said, however, that this result can scarcely be attained except the soil be of a nature to retain moisture, and except also it has been well soaked by the rains of the previous winter season.

Those advantages of thorough cultivation are strikingly illustrated among the orange orchards of Southern California. As a general rule the orange tree requires a large amount of moisture, and when each gallon of irrigating water applied to an orchard must be paid for, the quantity of water used cuts a figure in the year's expenses. It is found, therefore, by ample experience that by a system of careful cultivation of orchards as above suggested, a considerable saving in water tax may be effected, while the resulting crop has been still further benefited by this extra cultivation received. It may therefore be regarded as a safe practice to cultivate crops thoroughly and often during periods of drouth; and this rule holds as good for Ohio as for Arizona. As before stated, however, the culture should not be deep, and the finer the surface soil is pulverized the better, and if the top layer of soil be as dry as powder and as fine it will serve the purpose of a mulch all the better and give surprising results.

WATER POWER AND ELECTRICITY.

YEARS ago the miners of the West overran the mountains, looking everywhere for gold and silver; within the last few years another set of hunters have been busy searching out reservoirs for storing flood waters for irrigation; and recently a new set of prospectors have sprung up, who are engaged in a novel search. They are exploring the wildest cañons in the heart of the Sierras and Rockies, seeking out the smaller streams that have a high fall, for the purpose of converting this force into electricity for transmission for long distances for power, heat and light. Already steps have been taken to utilize some of this power for pumping by electricity for irrigation. The severe and crucial test, of continued operation over a considerable length of time over long distances is as yet of rare occurrence. There are, however, two plants in the United States that have successfully met the conditions of long distance, rough country, difficult climate, continuity of service, and a pressure above that ordinarily used. The first is that of Willamette Falls, Portland, Oregon. They utilize the power of the falls, fifteen miles away, for power, light and heat, at Portland, using Victor wheels of 300 horse-power, geared to horizontal shafts with which the dynamo belts are connected. Two alternating current dynamos are driven by each wheel. The current at the high pressure of 4,000 volts passes direct to the line of No. 4 B. & S. wire, which is carried on ordinary double-petticoat glass insulators across country. The current is received at 3,300 volts by transformers and reduced to 1,100 volts for distribution.

AT TELLURIDE, COLORADO,

another plant operates the Gold King mill. Here the wires are carried over mountain peaks steep and rough for twenty miles, the line in some places being perpendicular, in others having an angle of 45 degrees, and during the winter the snow is occasionally level with the top of the poles, while in the summer the lightning arresters are kept peculiarly busy, as high as forty-two discharges being noted in one minute on one occasion. The generator and motor are the same as at Portland. On this line and on the one in Oregon the line loss is 20 per cent. Both lines have been in operation successfully for over two years. Such results are valuable for showing what has been accomplished with new types of machinery in countries where line construction and maintenance are peculiarly difficult, with practically continuous service, with attendants who are not electricians, with high voltage, a long distance and large power. Long distance transmission of electricity has passed beyond

the stage of experimental trial and has received the stamp of commercial success.

An interesting test was made during the late electrical congress in Germany. Dynamos of large capacity operated by turbines in the river Neckar, at Lauffen, were connected by wire with motors at Frankfort-on-Main, 108 miles distant; 225 to 250 horse-power was generated at Lauffen, and 175 to 200 delivered at Frankfort; that is, 70 to 75 per cent. of the power was transmitted and from 25 to 30 per cent. lost, this including an initial loss of 8 to 10 per cent. in the generating dynamos, which might be somewhat eliminated by more perfect construction. The actual loss of energy during the triple process of transferring a current of over 200 horse-power into a current of small voltage but high intensity, transmitting this 108 miles over naked copper wires hung on ordinary telegraph poles by oil-trough porcelain insulators, and re-transmitting it into a current of ordinary pressure, at a line loss of 20 per cent. was remarkable.

Along the base of the mountains of the irrigation area there are many places where the water supply, that only needs to be lifted a short distance by pumps, is ample for large tracts of valuable lands. Back in the mountains, ten, fifteen, twenty miles away are living streams, tumbling idly down the rocks, that can be set to work driving the dynamos. The little copper wire connects with the pumps, and the water flows over the orchards. Pumping for irrigation has come to stay. The next step is to hitch on to the mountain waterfalls and pump by electricity.

WHAT ARE THE OPPORTUNITIES?

THE IRRIGATION AGE will gladly receive brief descriptions of opportunities for water power existing in various parts of the arid West. These natural powers are among the most valuable assets of communities and should be carefully studied. They are desirable adjuncts of all irrigation plants and of the utmost importance in working out ideal colony projects.

A FEW years will bring Asotin county to the fore as a profitable agricultural community, as the result of irrigation enterprises now under way. Arrangements have been completed by the Oregon-Washington Irrigation Company for constructing reservoirs in the Blue mountains, where the snows of winter and flow of springs will be stored up for obviating the difficulties occasioned by lack of summer rains, and the naturally fertile soil will be brought to a high state of productiveness.

PUBLISHER'S DEPARTMENT.

WHY HE CHOSE A HOME IN KERN COLONIES.

SECOND LETTER.

SAN FRANCISCO, CAL., Feb. 20, 1894.

LORIN JOHNSON:

MY DEAR SIR: The Midwinter Fair did not open as soon as expected, hence I have remained here longer than I intended, and therefore write you again concerning the questions asked by yourself and other friends. You will show this letter to them and thus relieve me of writing to each one individually. I quite agree with Mr. Ames and others that it is essential that we investigate thoroughly the standing of the gentlemen who own the lands, and also that we ascertain, beyond doubt, that they have a perfect title to the land and water and are able to convey such title to us.

Regarding the guarantees of the Kern County Land Co., of title to both land and water, I will simply refer you to the reports of Bradstreet's and Dun's Commercial agencies. This property is owned by two of the wealthiest men in California, each of whom is probably worth twenty million dollars, exclusive of his landed interests, valued at ten million. Mr. Tevis, the president of this Company, held the position as president of the Wells Fargo Express Company for twenty years and is one of the best known men on the Pacific coast. Mr. Haggis is an extensive owner of Montana copper mines, Utah gold mines and Nevada silver mines and is also known throughout the world as one of the most successful horsemen in this country.

You ask why the owners of the land desire to sell their property, if they have no indebtedness and horticultural pursuits are so profitable as represented. Fruit growing, unlike wheat farming and stock raising, is more profitable on a small scale than a large one. This company has 60,000 acres in alfalfa, but no company could successfully cultivate one-fourth that area in fruit trees, as they require careful attention and the details of that work could not be successfully managed on such an immense scale. As fruit growing is so much more profitable than wheat farming or stock raising in such fertile soil and in such a genial climate as the Kern delta affords, you will readily see that the land should be devoted to that purpose.

Again, with half this land in cultivation by prosperous fruit-growers, you can easily understand that the remainder would be worth as much as the whole would bring at the present time. Imagine the increase in land values that would accrue from the settlement, on this immense tract, of 100,000 prosperous people. This land was not marketable at ten

dollars an acre before the Kern County Land Company commenced to colonize this county. Not only will the company's land be increased in value by the colonization work now under way, but those who purchase land now will share in the "unearned increment" or increase in values. With such a settlement of the surrounding country, Bakersfield will also share in the prosperity and become the most important town between Los Angeles and San Francisco.

The Santa Clara valley, famous throughout the United States for its prosperity, is due almost entirely to its success in prune culture, yet I find as good results from prunes here as there, though there are but few bearing orchards in the delta and they are mostly young. I could not find a good orchard in the Santa Clara valley for sale at a less price than \$1,000 per acre, yet it was stated by persons who reside there that the loss occasioned from drought every four or five years was sufficient to pay for the most expensive irrigation system ever constructed in California.

I found in the Sacramento valley, famous for its peaches, apricots and pears, that land is much higher than in Kern county, yet they also have an occasional drought to contend with, and have as yet no extensive irrigation system to supply the necessary amount of water in dry years.

I was greatly pleased with Riverside and Redlands colonies, though I found land there much higher than elsewhere. Choice land in either of those places, well located, is held at from \$300 to \$500 per acre, including water rights, and a great many wealthy people from the East consider it a good investment at these prices.

Now, in regard to the healthfulness of the climate in Kern county, I must say that I went there fearing that I would find nearly as many graveyards as orchards, from the reports given me at other places, but if such is the case, most of the graves are unmarked, and those now living will not give information concerning the spots where they have buried their dead. Judging from the many healthy people I saw in Bakersfield, these reports are put in circulation by real estate agents who are jealous of the prosperity in Kern county. I find from the official reports that the death rate in Kern county is below the average of the counties in this healthful State.

Now, regarding the statements made to you that irrigated fruit is not so good as that grown without irrigation, I need only refer you to the fruit markets in the Chicago papers. You will notice that choice

California oranges bring a higher price than those grown elsewhere, yet I have not found even a real estate man in California who claimed that oranges were grown anywhere in the State without irrigation. The persons referred to in my last letter, who had lived ten years in the Greeley Colony of Colorado, told me that all their potatoes were grown by irrigation and that they invariably brought the highest prices in the eastern markets. Choice wheat is also grown in Colorado as in California by irrigation; so are the Fresno raisins, which bring the highest price obtained for the American product. These, with similar reports which I have learned from people who formerly lived in Utah and other irrigated regions, have convinced me beyond doubt that the statements circulated against fruits grown by irrigation are started by real estate agents or fruit-growers whose interests are best subserved by falsehoods, or who are ignorant of the facts. I found no person in California who has had experience in cultivating the soil which is supplied with first-class water rights who desire land anywhere for fruit-growing where irrigation is impossible. In fact, the official statistics of California show that nearly all the immigration to this State during the last ten years has been to the irrigated counties, and I see no indication of a change in this regard.

Comparing the California horticulturist with the Illinois farmer concerning the esteem with which each is regarded in his particular locality, I find a marked contrast. There he is called a hayseed by the shopman who lives in the little village, but here he is regarded in much the same light as the country gentleman of England. In the colonies where the orchards have arrived at full bearing age, I find that their prosperous owners enjoy the ideal country life. In their homes are found more papers, magazines, books and pianos than could be found in my New England home when I left there, or can now be found in the richest portions of Illinois. The profits from fruit growing enable the industrious and frugal to enjoy the comforts of life here as nowhere else that I have seen or heard of. There is something in California besides the pleasure of climate and scenery, for while they relieve the monotony of country life, the climate brings health to the invalid and makes possible the luxurious vegetation.

The little farm well tilled brings prosperity to its owner, and makes close neighbors, which enables the country people to enjoy many of the advantages of city life without being compelled to endure its vices.

This State is a most desirable place for children and old people. Here they can enjoy God's sunshine more than 300 days in the year. It was quite properly remarked by a real estate agent in Bakersfield that California was the latest of creation, just next to paradise, so that all who visit this part of earth will have a faint conception of the promised land "from whose bourne no traveler returns". Judging from the many interviews I have had with people in this state, none of them desire to return "back East", as they call it, except to tell their friends of the enjoyment in this land of sunshine.

California was first called the Golden State on account of that precious metal found so abundantly here in 1849, but that is also a proper designation now by reason of the golden fruit and the metal given and exchanged for the same.

Yes, there is poverty in California, and that will be found anywhere, but there is less excuse for it here than elsewhere. Many shiftless people come here, as they went to Oklahoma, and are now searching for some other Eldorado, but they are too indolent or careless to pick the gold from the trees, even if it could be found there. People who can keep the mortgage off the farm by the severest kind of industry and economy in the eastern States, could soon enjoy sufficient prosperity here that they might afford the comforts of life as well as the necessities. A single man who comes here to make a home on a farm should have a thousand dollars or more ready cash, and a married man double that amount. Of course most of the millionaires of California came here poor, while others came with small fortunes and lost them by speculation. In my estimates I refer only to the average man who is willing to work and economize, and who will leave all kinds of gambling alone, whether it be the card-table, mining stocks or town-lot booms. Some will succeed here who bring no money with them.

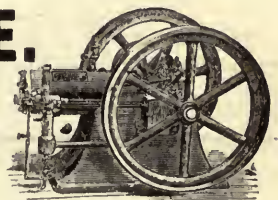
Those of our friends who have small incomes from their business in Illinois can remain there if they desire until their orchards will yield an income, and employ others who desire to come at once to care for

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the orchards during the first two or three years. Anaheim, one of the prosperous colonies of California, was established in this manner by some German residents of San Francisco.

Now, in view of what I have already written, I shall meet the objection to "a little twenty-acre farm, costing as much as a quarter section in Illinois." In Utah I saw a small patch of ground, less than an acre, on a Rocky mountain side, from which Mr. Haggin and his partner have taken millions of gold, though this desert spot looked less valuable to me than a town lot ten miles from the center of Wichita, Kansas, after the boom collapsed. The Ontario mine is valuable for what it produces, and California land is valuable for the same reason.

I cannot tell you what will yield the largest net profits in Kern county, as peaches, prunes, apricots, almonds, olives, every variety of grapes and vegetables, berries and alfalfa all do well here. Most of the fruit trees referred to yield from \$200 to \$300 worth annually from the fourth or fifth year after setting.

Now in regard to the most desirable place for residence in California, I will say that I prefer either Los Angeles or Oakland, as they both possess all the conveniences of modern city life, in addition to the glorious California climate. However, there are no vacant fruit lands for sale near the center of either of these cities. My brother was anxious to secure such a location for an orchard, but could neither find the vacant land there nor the money to pay for it. If my Kern County orchard proves as profitable as I have reason to believe, I shall cherish the hope that I may some day live in one of the cities referred to, while enjoying the income from my orchard in Kern county, providing Bakersfield does not become sufficiently metropolitan for me.

Yes, I admit that I am enthusiastic about California, though I believed before coming here that I was proof against the "California fever" as it is called.

I have investigated the danger from earthquakes and find that fewer people have been killed by them here during the last twenty years than from the one cyclone in Illinois two years ago. Sunstrokes are entirely unknown here, also hydrophobia.

I shall hope to see you on February 1st and answer many questions in person that would require too much time by letter.

Very truly,

AL. J. MILLER.

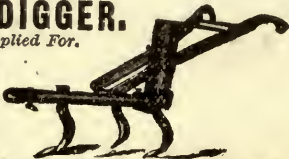
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W. L. COGGESHALL, West Groton, N.Y.



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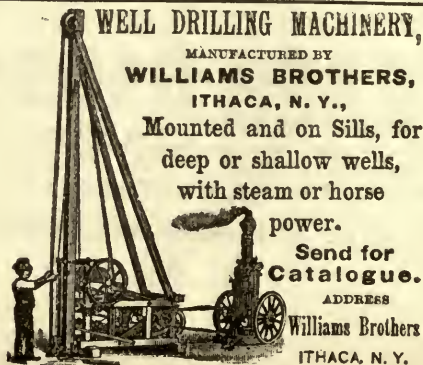
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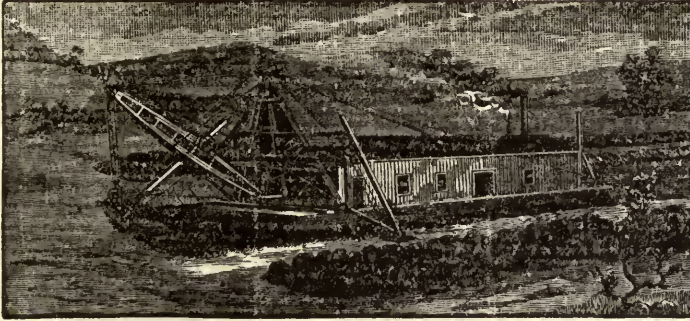
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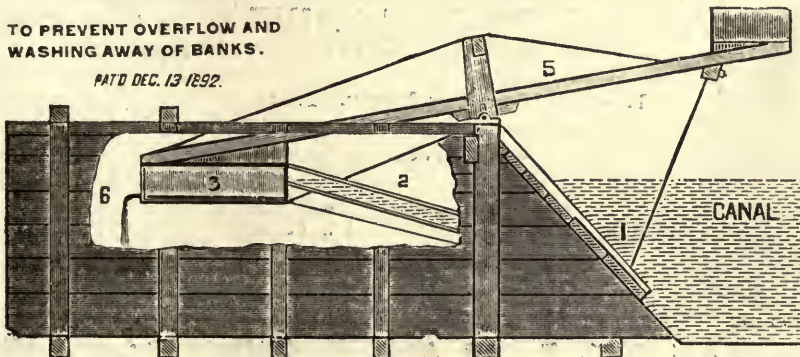
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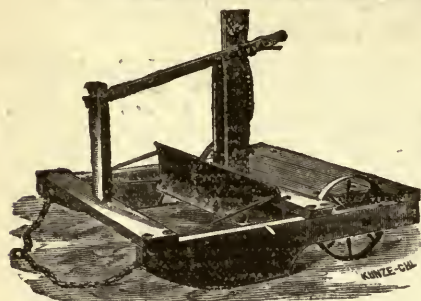


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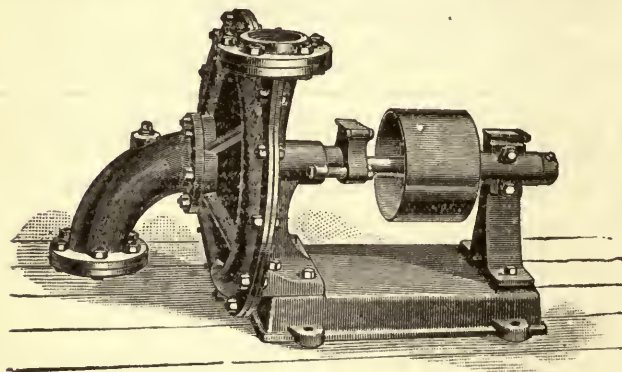
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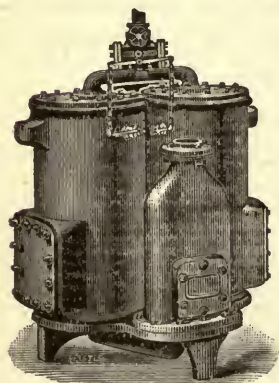
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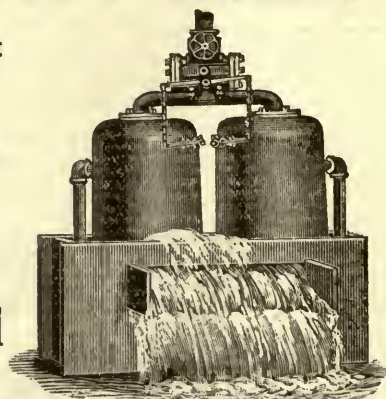
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THE MAKING OF VAL VERDE COLONY.

THE MOST REMARKABLE PROPOSITION IN SOUTHERN CALIFORNIA.

LOOKING FOR PROSPERITY.

In the eastern and middle States thousands of people who have formerly added something each Saturday night to their savings account are now drawing upon the slender principal. They have not much confidence in an early and enduring revival of business, as conditions existing throughout the world do not seem to favor it. Their small capital cannot be invested at home in such a manner as to earn them a living. Farming under precarious rainfall requires a large acreage and involves the discomforts and loneliness of life in a sparsely settled country. The problem, How shall we improve our condition? seriously confronts these people to-day for the first time in their lives. And when intelligent people bring their minds to bear upon it they discover that there is but one satisfactory answer. This is to go to Arid America. There a very little money will go a very long way to purchase a farm, for there a farm is a matter of ten or twenty acres. That means not only a small investment. It means near neighbors, and that banishes the ugly spectre of loneliness from country life. It means intense production from each acre, for in the arid region God furnishes the blue sky and the unhampered sunshine and man borrows the water from the neighboring mountain peaks. He applies it just when, just where and in just such amount as the best knowledge and experience tell him. That makes farming a science and lends to it a new fascination in the eyes of intelligent men. This means also the utmost diversification of crops, since with irrigation everything is produced with equal facility. These are the advantages of irrigation wherever it is practiced in arid countries, but if one is going to the far new West another question arises, and that is, Where is the best place to go? The answer to this is still easier.

SOUTHERN CALIFORNIA THE GOAL.

Every State and Territory has peculiar advantages, but the ideal conditions for prosperous and satisfying home-making exist only in Southern California. If you look at a relief map of this region you will think that it consists exclusively of mountains. The little green valleys that nestle between the giant hills seem insignificant, indeed, in comparison with the expanses of the imperial Mississippi valley. And they are, indeed, but slender marks upon the map by comparison. But this has a mighty meaning to the man who is buying land. The amount of tillable soil is sharply limited by the mountain ranges, and the



J. W. NANCE.

THE colony-builder is having a busy season in Southern California. The first boom in this Italy of America was based on climate and town lots. The second era of growth is based on climate and irrigated farms. Now, climate alone cannot produce anything on a town lot, but climate has a great deal to do with the production of things on the irrigated farm. Everywhere in the West the day of speculation is succeeded by the day of industrialism, by which is meant a period when capital and human energies are directed to the making of realities rather than the creation of fictitious values.

This industrial epoch has come to Southern California earlier than to other portions of the arid West, for the logical reason that here the first preliminary fever of speculation was contracted and cured earlier than elsewhere. To-day Southern California is in the very tide of development, while elsewhere the channels of trade show the feeblest pulse in two decades. At first thought this seems anomalous, but just the contrary is true. Colonies are springing up in California not in spite of our idle industries, but because of them.

THE IRRIGATION AGE.



VAL VERDE TRACT AND PERRIS VALLEY, FROM KNOLL NEAR THE CITY.

amount of water available for irrigation imposes a limitation even more severe. Nature has limited the amount of water and land in Southern California, but nothing can limit the population which must live here in the future. Year after year the stream swells in volume, and so long as this tender sky bends above these rugged, snow-capped mountains, uniting in a single picture the charm of summer and the majesty of winter, so long will the army of home-seekers, searching for an earthly paradise, march steadily into these valleys of our far Southwest. This means constantly enhancing land values. The demand for land must increase, but the supply cannot increase. So the person who buys at present prices knows that twenty years hence, the inevitable increase of population will have multiplied the value of his land, even if he has not improved it in the meantime.

THE VERY BEST IN CALIFORNIA.

The present selling price of land in Southern California varies a good deal. Where it is cheap it is generally remote from transportation facilities, or the water supply is problematical. Even in such localities the price generally ranges from \$50 to \$100 per acre. In established communities having the advantages of railroads and completed irrigation works the price is generally from \$100 to \$300 an acre. This is before the plow touches the soil. Improved land in bearing orchards is worth from \$500 to \$1,000, and upward. These are the general conditions. But there happens to be one place in the most fertile and beautiful part of Southern California, where all the

advantages of low prices are combined with the certainties of railroad and existing water supplies and an established community. If there is another such place in Southern California proper, it is unknown to the writer. The place referred to is the Val Verde tract in the heart of Perris valley, which is within about fifteen miles of the famous orange colonies of Redlands and Riverside. Nowhere is the soil more fertile, the lay of the land more favorable, the climate more genial, and the surrounding mountain scenery more inspiring. The Santa Fé railroad runs through the center of it, and best of all, the entire tract is piped with water from the great Bear Valley reservoir, thirty-five miles away, in the San Bernardino mountains. The city of Perris is within fifteen minutes' drive, and Los Angeles itself is but seventy miles to the westward. And land in the Val Verde tract, with all these advantages, is selling to-day for *\$75 per acre!* There is nothing like it for the price in the United States, and nothing superior at any price anywhere, even in Southern California.

THE MAN BEHIND IT.

Wherever there is a colony in Southern California there will be found a brain and heart behind it. This section is peculiar in that respect. Some adventurous spirit sees for the first time, as in a vision, the possibilities of a certain valley through which perhaps many thousand men, as unthinking as their horses, have ridden before. Such men are essentially discoverers. They say to themselves, "What a beautiful valley! How I would like to water it and make it

THE MAKING OF VAL VERDE COLONY.

blossom! How many farms and vineyards, gardens and orchards, each with a red-roofed cottage in its midst, this valley would contain if water could be found for the working of the miracle!" Behind nearly every successful community in Southern California stands the figure of the solitary pioneer, who, with a soul half poetical, half practical, first determined to organize prosperity where nature had spread the raw materials and time had patiently awaited his coming. In the case of Perris this man of pluck and faith was J. W. Nance. Nine years ago he settled on one of the grain farms in the heart of the valley and began to study the problem of how to conquer the difficulties which lay between the dry plain in its natural state and its immense possibilities under irrigation. The railroad was already there. The whole problem lay in getting water for irrigation.

A UNIQUE IRRIGATION SYSTEM.

Space is not available to describe the manifold difficulties with which Mr. Nance contended and which he at last successfully overcame in solving the question of water supply. But he solved it. And the system which he provided is unique in two respects. First, it is owned, controlled and administered by the people of the locality themselves. In this respect it realizes the dream of Edward Bellamy. The recent International Irrigation Congress selected it as the type among all the irrigation districts organized under the Wright law of California, going to the extraordinary length of appointing a committee to investigate

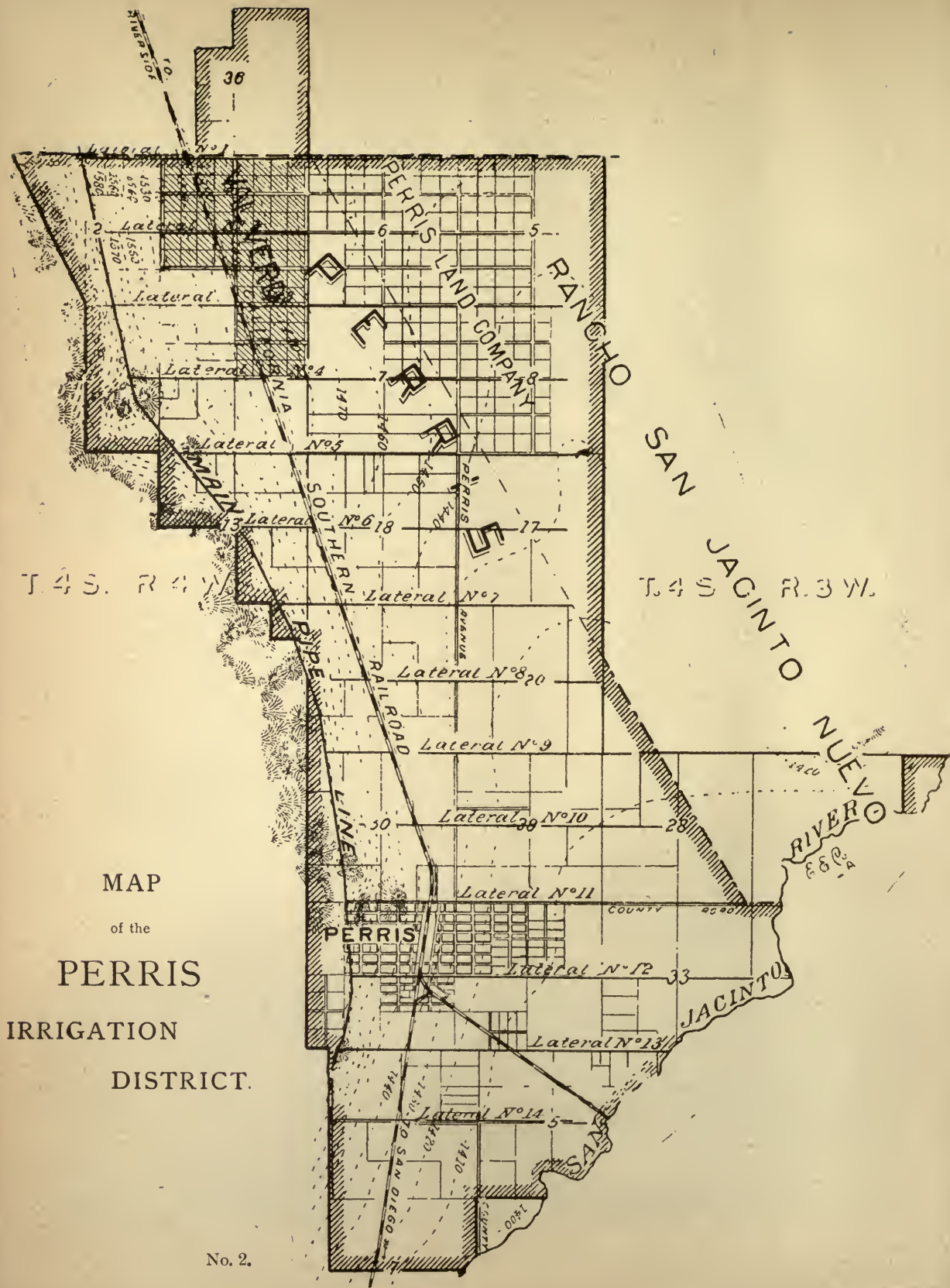
it and incorporating its flattering report as a part of its official records. The second feature in which the Perris system is unique is in its entire absence of open ditches. The water is carried throughout the district in underground pipes and there is sufficient pressure to throw it high in the air when desired. There is absolutely no waste by evaporation or seepage. Every drop of the pure mountain water counts. The farmer goes even to the length of planting a strip of alfalfa at the foot of his orchard to absorb the surplus water that escapes through his orchard and garden. The 30-inch main pipes traverse the entire district, which consists of 13,000 acres, and sublaterals are extended across its width. Smaller pipes carry the water to the highest point of each legal subdivision. From these points it is conducted to each ten-acre tract by narrow wooden flumes which cost but a trifle. The system is the most perfect and economical to be found in California, where methods and systems are superior to those in any other portion of the United States. About 1,500 acres were irrigated last season and 1,200 acres of new planting are now under way.

HOME OF THE ORANGE AND LEMON.

The Perris valley and the Val Verde tract are clearly in the citrus belt of Southern California. While the altitude is 1,500 feet, there is nothing to prevent the successful culture of oranges and lemons. The present season has been colder than usual, and the writer has examined the orchards of Redlands,



ORANGE GROVE OF MESSRS. HUNGATE, TWO YEARS OLD NEXT MAY.



MAP

of the

PERRIS

IRRIGATION

DISTRICT.

R.6.W.

R.5.W.

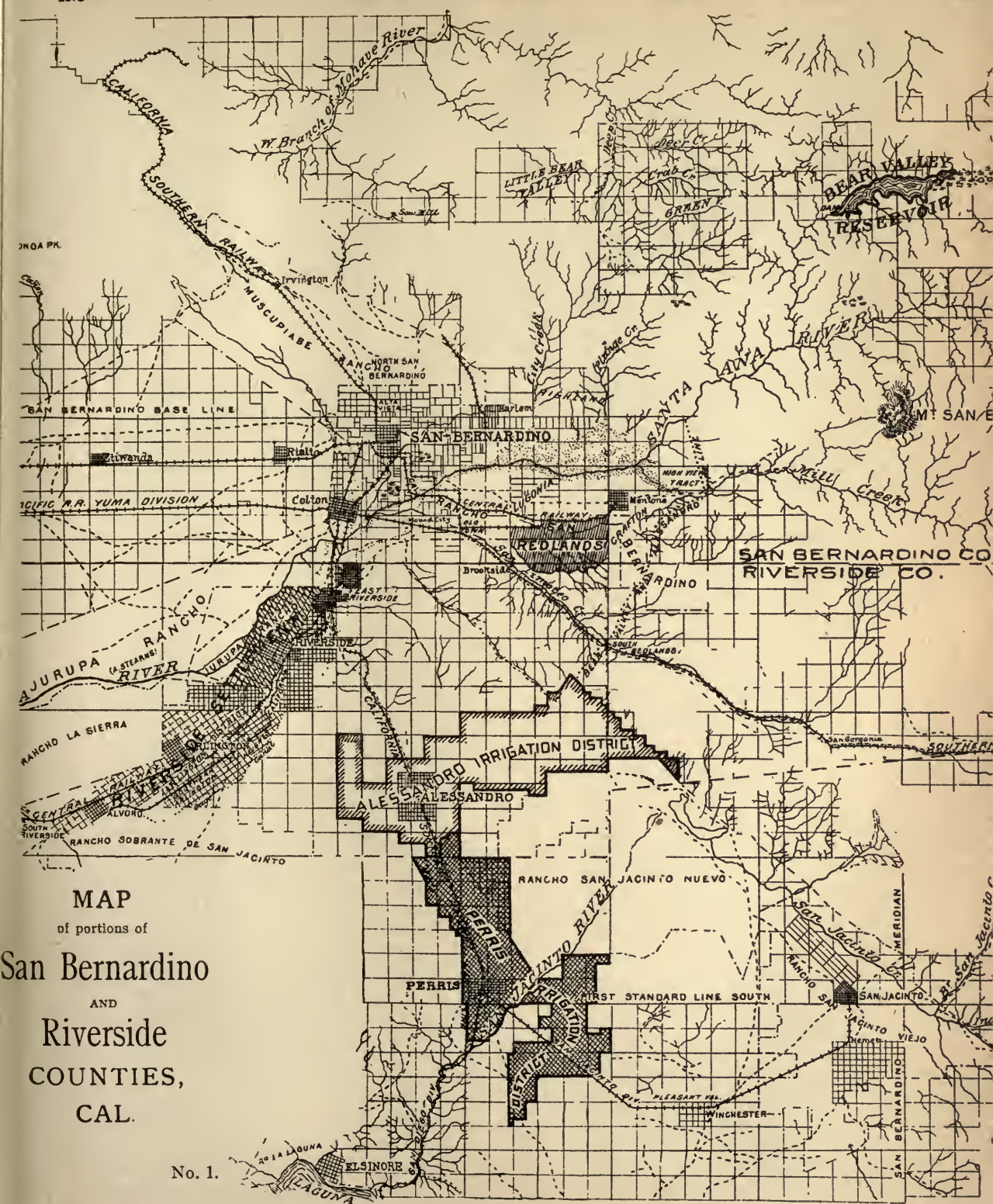
R.4.W.

R.3.W.

R.2.W.

R.1.W.

R.1.E.



THE IRRIGATION AGE.



YOUNG ORANGE GROVE. HYDRANT CONNECTED WITH IRRIGATION SYSTEM. VAL VERDE TRACT.

Riverside and several other of the well-known colonies to observe the results of the frost. He is ready to state without hesitation that the young orchards of Perris stood the test far better than those of other localities. With the exception of a few trees in a single low spot, nothing was injured at Perris, not even tender nursery stock. On the contrary, one orchard planted as late as last May from yearling buds must be pronounced the finest of its age in the State. It was absolutely unharmed. It would cost a man his reputation for veracity to tell the truth about this particular orchard. The illustration showing an orchard and farm house was taken on Washington's birthday and shows the estate of the Messrs. Hungate. These orange trees were planted two years ago next May from yearling buds and bore a few very handsome oranges this year. The Hungate family came from Hutchinson, Kansas. They told the writer that they were perfectly delighted with the climate and country, and would much rather own twenty acres in the Perris valley than 160 acres in eastern Kansas. While their trees are growing they supply their table with everything required in the way of vegetables and small fruits, while the barn yard and the alfalfa patch furnish poultry, pork, eggs, butter and cheese. They are thus sustaining themselves while the trees are growing and two years hence will be realizing a handsome income from citrus and deciduous fruits, to which their twenty acres are largely planted. Theirs is a typical in-

stance, illustrating what dozens of other settlers are doing and hundreds more may do in this favored district. Among the larger orange orchards is the 40-acre tract of Hon. T. J. Morgan, former commissioner of Indian affairs. Within five years the Val Verde tract will be a large shipper of oranges and lemons and the quality of its product will be equal to the best in California.

OTHER PRODUCTS OF THE LAND.

It has already been said that everything that grows can be produced in this locality. It is unnecessary to enumerate, but it may be said that the colonists are planting largely to orchards. At present the largest acreage is in prunes, next peaches, third oranges, fourth apricots, fifth paper-shell almonds. One 15-acre farm is planted one-third to peaches, one-third to prunes, and one-third to the Thompson seedless grapes. The writer had the pleasurable sensation of picking ripe strawberries from a vine full of blossoms on February 22. It is hardly necessary to say more of the possibilities of the valley. There certainly is no place in the world where it would seem easier to prosper. Upon ten acres an ordinary family will do very well indeed, but twenty acres will be the favorite unit. The country is rapidly filling up, and prices cannot be expected to remain long as they are.

ELECTRICITY IN PERRIS VALLEY.

The people of the irrigation empire expect to make large use of electricity. Mr. Nance has not forgotten

THE IRRIGATION AGE.

VOL. VI.

CHICAGO, MARCH, 1894.

No. 3

THE PROGRESS OF WESTERN AMERICA.



HON. W. J. MCCONNELL,

Governor of Idaho, President of the Trans-Mississippi Congress.

The Trans-Mississippi Congress has no counterpart in past or contemporaneous history. Popular conventions are of common occurrence, and particular topics have frequently called into being representative bodies of this kind which have flourished for a time and passed away. These have generally been directed to the promotion of reforms in the realm of politics, morals or society, or the championship of great public improvements, like railroads or harbors. But in none of these conventions do we find a parallel to the Trans-Mississippi Congress. This latter is a permanent body, and is devoted to no single idea. Although it verges close upon the boundary of partisan politics, since it is only through the machinery of

political parties that legislation can generally be obtained, it is the fixed purpose of this organization to formulate industrial policies for the West. The common criticism of the Trans-Mississippi Congress is that it was begotten and nurtured by the narrow spirit of sectionalism. This would be true of a similar body assembled in the North, the East or the South. It is not true of this annual assemblage of representative men of the West. To understand the meaning of this distinction is to grasp the mighty significance of Western America as a factor in the future life of this republic.

A Sectionalism that is Nationalism. There is a sectionalism that is the broadest nationalism. To hold a convention in Boston to promote the peculiar interests of New England would be petty provincialism, because New England is, in a sense, private property. It has little or no undeveloped resources. It offers no field for the exercise of national energies. Its great history is made and recorded. But the western half of this continent is for the most part a national estate. It is impossible to create anything in the new West that does not add something to the wealth and glory of the nation. There is no such thing as western provincialism. Its sky is too wide, its mountains are too high, its prairies are too measureless. The western man is naturally a man of broad national views. The child of New England, of the South, or of the Central West, he has been broadened by travel and mingling with men from all parts of the Union and all over the world. There has been much talk of sectionalism in connection with the silver question. It is the idlest nonsense, since the material for sectionalism does not exist in the western mind. This is not saying that men do not love their States as well beyond the Missouri river as east of it, but they see those States as a part of a great nation. When a Territory is admitted to statehood it is not the thought that sovereignty has been acquired that thrills the people. They do not

cry, "Hurrah! we are a sovereign State," but rather, "Hurrah! our star has gone into the flag of the Union." And to render that star as resplendent as the sun is but to add new glory to the symbol of nationality. Thus it is national pride and national aspiration that sustains the Trans-Mississippi Congress and makes it a living force in the life of the West. There is clearly no danger in a sectionalism of this character. Doubtless it would be possible for the nation to pursue a policy which in time would embitter the western mind and sow the seeds of a pernicious and dangerous sectionalism, but to-day the Trans-Mississippi Congress is a body of empire-builders, seeking to organize prosperity in the only wide field that remains to be conquered by American genius.

Three Western Policies. The session of the Trans-Mississippi Congress held during the past month at San Francisco was the sixth annual meeting of that body. While its members are not authorized representatives in the sense of having been chosen by legal election, they may still be accepted as reflecting very accurately the opinions of their several commonwealths. There are certain public policies which the western States and Territories regard as very vital to their welfare and hence to national progress. Free coinage used to be regarded as the first of these policies, but in the last two years the reclamation of the arid lands has squarely disputed the position. It is now generally acknowledged that irrigation is the foremost of western problems. Free coinage is a cause still dear to the West, but it has come to believe that if the rest of the country can get along with a small circulating medium the West can do so just as well, since it is producing about all the gold that finds its way to the mints. The third great policy that western men have at heart is the building of the Nicaragua canal, which they expect will largely increase their commerce and reduce freight charges. There are many other minor problems, but irrigation, silver and the interoceanic highway represents the larger part of the western aspirations. Now, none of these things are of narrow local importance. A national irrigation policy would mean homesteads for millions of American families; free coinage would mean a radical change—western men think for the better—in national finances; the canal through the Isthmus would mean as much to New York as to San Francisco.

Land Cession Again. It was doubtless impossible to prevent an expression of opinion at the recent Congress on the subject of the cession of the arid lands to the States. If we mistake not, the Trans-Mississippi Congress has five times before declared in favor of the proposition. But if the friends of the present organized irrigation movement



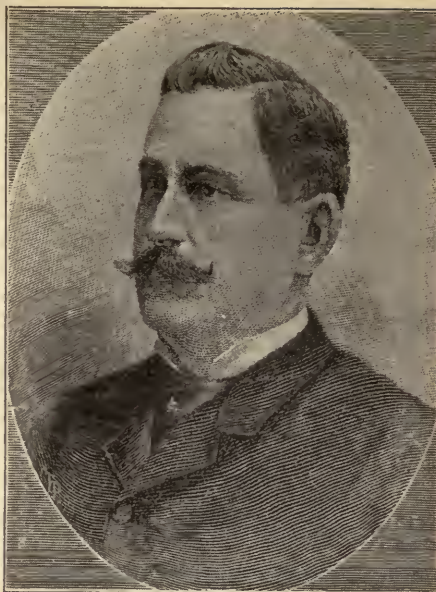
L. H. TAYLOR,
Of Reno, Nevada.

could have had their way the subject of cession would not have been dealt with at this time. They would have much preferred to have the Congress recognize the State Commissions now engaged in studying the question in all its aspects with a view to the formulation of a definite and final policy at the next Irrigation Congress. It is from the thorough work of these commissions, dealing with the subject at close range, rather than from a body which can sit but a few days while dealing with a large number of complex questions, that a really valuable verdict can be expected. Previous to the Los Angeles Congress THE IRRIGATION AGE squarely favored the policy of cession, but at that time it was agreed that the question should be left in abeyance until the commissions had performed their work and rendered their reports. Good faith demands that this understanding shall be observed by all interested parties. It is our belief that the final result will be a compromise measure, designed to furnish ample safeguards against the dangers which sincere men have seen in the policy of land cession, while at the same time preserving the essential features of State supervision and control for which equally sincere men on the other side have contended. The dispute is not as to ends, but as to means, and since everybody is aiming at the same destination it ought to be possible to discover some common pathway. We have full confidence that this will be the result of the next Irrigation Congress, and it is to be hoped that everybody will

study the subject with this end in view. Men can make their own plans in their private affairs, but individual views must be harmonized when public policies are to be molded.

No Change of Front. Mr. Willard E. Allen writes to the editor of THE AGE as follows: "Those who quite agreed with your former criticism of Major Powell's utterances in his celebrated speech at Los Angeles are somewhat at a loss to understand your present attitude toward that gentleman. I write to enquire whether the fact that you are now giving him space to elaborate his views in the pages of THE AGE is to be construed as a change of front on the very important point of the water supplies and irrigable public lands of the arid West?" This is a question which has come to us from several sources and to which we gladly make reply, although in the two previous numbers of THE AGE the matter was dealt with quite extensively. The editor of THE AGE arose in his place at the Irrigation Congress and denied that the Territory of Utah had no more water available for the reclamation of arid public lands. In the November issue of this journal it was stoutly contended that it was erroneous to state broadly that "not another acre of government land should be granted for irrigation purposes." We have not retracted or modified these views, but we are not unwilling to have them discussed by any person who is competent to do so. We have no personal quarrel with the Director of the Geological Survey. We are interested in learning the facts about the water supply in the arid regions rather than in the payment of ancient grudges. This being so, we are not only willing, but very glad, to devote space to the discussion of the vital questions raised in the speech of Major Powell, and now being fully dealt with in his series of papers in THE AGE. We reserve our final conclusions and criticisms until all the evidence is in.

Individuals are Nothing. We have no sympathy whatever with that view of editorial duty and opportunity which seeks to make personal capital or personal grievance out of expressions of opinion on purely public questions. The object of the irrigation movement is to build a new civilization in the arid regions of the West. The foundation of that development is water supply and irrigable land. It is of the highest importance that all possible information concerning these two vital factors should be acquired and disseminated. THE AGE has always kept this great central thought in view. If two men whose opinions carry weight differ about a question that goes down deep into the vital part of a great cause it is certainly desirable to find out who is right and who wrong, since it is the facts, and not the



HON. CHARLES W. DABNEY, JR.,

Assistant Secretary of Agriculture.

opinions, which will finally affect results. It sometimes happens in such cases that neither party is wholly right or wholly wrong. Whether that be true or not in this case is of no consequence, but it is a matter of the highest consequence that the truth should be made known. The publication of Major Powell's elaborate articles and the discussion which will naturally ensue will probably be the greatest possible contribution to this end. If so, THE AGE will have rendered a valuable service by its course in this matter. Individuals are nothing and the civilization which we are trying to evolve from the desert is everything. When THE AGE has no better theme than miserable personalities it will retire from the field.

Needed Utah Legislation. Hon. Charles S. Varian has introduced three measures into the Utah Legislature that will have a tremendous effect for good if passed. They provide for the creation of a Board of Horticulture, for the protection of fruit trees and for the extermination of pests and prevention of diseases. If these measures, having been enacted, are rigidly enforced, an important addition to the wealth of Utah will be realized. Utah is a fruit country of large capabilities. The yield is abundant and the quality unsurpassed. The flavor of peaches, apricots, plums, apples and other delicious fruits produced among the valleys of this "mountain-walled treasury of the gods" is equal to the products of the

most favored portions of the globe and far superior to the average fruit found in the market. But magnificent orchards have been left defenceless against the commonest pests until it is hardly possible to find a specimen of really perfect fruit. The thing has gone so far that nothing but stringent laws rigidly enforced will now avail to abate the evil; if this is done, and there is then a systematic effort to improve the methods of putting the fruit upon the market, the Utah fruit industry will expand to large proportions and yield large and steady profits.

**The
Runoff
Map.**

By an unaccountable error the map showing the runoff of the United States, published in the last number of *THE AGE* in connection with Major Powell's article, was credited to the Weather Bureau. It is in reality the result of thousands of observations and computations made by the Hydrographic Division of the Geological Survey. To Mr. F. H. Newell, more than any other individual, credit is due for this laborious and enlightening work, which will benefit those engaged in the irrigation industry for many years to come. Mr. Newell belongs to that class of scholarly scientific young men who have been attracted into the government service by the opportunities it offers to perform notable work in exploring new problems and new fields. He has an enviable amount of achievement behind him and apparently a very important career ahead of him. He is mapping the ground whereon the great developments of the next century will work out undreamed-of results.

Major Powell's Article. Over a dozen letters have been received by *THE AGE* calling attention to the mistake in Major Powell's article in the last number. It is evident to any one who carries out the calculation that it should read: "If the crop of hay on an acre is two tons the acre of grass will transpire *one and eight-tenths* inches of water," instead of *18 inches* as stated.

Major Powell sends us the following letter in this connection.

DEPARTMENT OF THE INTERIOR, }
UNITED STATES GEOLOGICAL SURVEY, }
WASHINGTON, D. C., Feb. 15, 1894.

MR. WILLIAM E. SMYTHE, EDITOR OF THE IRRIGATION AGE, 1167 the Rookery, Chicago, Ill.

Dear Sir:—In reading my article on "The Water Supplies in the Arid Region," in the February number of *THE IRRIGATION AGE*, I have discovered an error in the upper paragraph of the right-hand column of the 54th page. From the wealth of illustrations at hand I selected one which involved an error, and I was so limited for time in the preparation of the article that proper examination of the manuscript was not possible. Had I seen printer's proofs the error would

doubtless have been detected. I am preparing another article in which the subject of the absolute duty of water will be set forth in a manner that will exhibit the facts more thoroughly, and I propose to offer it for publication in *THE IRRIGATION AGE* after the appearance of the article on "The Ownership of the Lands of the Arid Region." Please publish this statement.

Yours cordially,

J. W. POWELL.

From The Graphic, Chicago, Ill., Nov. 19, 1892. Charles William Dabney, Jr., Ph. D., LL. D., scientist and educator, was born at Hampden-Sidney, Va., in 1855. He is the son of Robert Lewis Dabney, D. D., LL. D., theologian, many years a professor at the Union Theological Seminary of the Presbyterian Church, now professor of philosophy in the University of Texas, and was "Stonewall" Jackson's chief-of-staff and biographer. President Dabney graduated at Hampden-Sidney College with the degree of A. B. in 1873, taught a classical school one year and graduated at the University of Virginia in 1877. He was professor of chemistry and mineralogy at Emory and Henry College, Virginia, 1877 to 1878, studied chemistry, physics and mineralogy at Berlin and Goettingen, Germany, from 1878 to 1880 inclusive, receiving the degree of Ph. D. at the latter university.

He was elected professor of chemistry in the University of North Carolina just before returning to America, and soon thereafter was elected State Chemist of North Carolina. In 1881 he became Director of the North Carolina Agricultural Experiment Station at Raleigh, and also State Chemist of the Geological Survey and Board of Health. While there he published a number of papers in the scientific journals on points in organic and agricultural chemistry, a large number of bulletins and five annual reports of the Experiment Station. He conducted explorations for phosphate in eastern North Carolina, and was the first to discover and bring these deposits to the attention of the scientific and commercial world. He made similar explorations of the pyrites deposits and made collections of the useful minerals of the same State for various expositions and the State museum. He discovered cassiterite (black tin) and a number of other new and valuable minerals in this section. Publications on these subjects were made in State reports and the journals of various scientific societies. Dr. Dabney was the representative of the State of North Carolina at various expositions and elected the chief of the department of Government and State exhibits of the New Orleans World's Exposition of 1884-'85. As chemist to the State Board of Health of North Carolina he published various papers on drinking waters, foods, drugs, etc. While in North Carolina, Dr. Dabney was instrumental in providing buildings, with labora-

tories, glass houses, etc., for the Experiment Station, in organizing and equipping an experimental farm, a State weather service, and a permanent exhibit of the State's resources. He became at this time greatly interested in technical education, and wrote and lectured a good deal on the necessity for this kind of education in the South. He was interested in the establishment of an industrial school at Raleigh, N. C., which has since become a college of agriculture and mechanic arts.

In 1877 the Board of Trustees of the University of Tennessee, desiring especially to strengthen their institution in the sciences related to the industries and engineering, elected Dr. Dabney to the presidency, he being then only thirty-three years of age. During the time he has occupied the presidential chair the courses of study have been enlarged to include many of the sciences, and new laboratories have been erected for mechanic arts, chemistry, physics, botany and zoölogy, each. In three years three new departments have been opened, the number of professors, the number of students and the income of the institution have all been nearly doubled. Dr. Dabney received the degree of LL. D. from Davidson College in 1889. He is a member of American and German chemical societies, of the American Institute of Mining Engineers, of the Virginia Historical Society and other similar organizations.

New Railroad Building.

In spite of the talk of the hard times in the East the same spirit that built the Union and Central Pacific railroads is still alive and hard at work in the West, and three roads are now building that will make accessible new and fertile portions of the great Southwest. For years these roads have been dreamed of. Now men

are actively engaged in pushing them into the land of sunshine, fruit and flowers. The Santa Fé, Prescott & Phoenix railway is a leader in the field. This is an enterprise of vast importance to Arizona, and is now in rapid progress toward completion. The section between Ash Fork and Prescott has been in operation since the 1st of May, and rails are now being laid on the twenty (20) miles of grading south of the latter city, and steps being taken for completing the intervening gap between the end of that section and the city of Phoenix, its prospective terminus.

The completion of this road, which has been Arizona's greatest necessity, under the adverse financial conditions obtaining ever since the inception of the enterprise, is as eloquent an expression of the faith on the part of its promoters in the possibilities and resources of the Territory as could be had. The inestimable advantages to accrue from the opening of this line are too many to enumerate within the limits of a magazine article. Suffice it to say that the Salt River valley, one of the richest irrigated agricultural sections of the Southwest, will on the completion of the line find quick access to the markets of the North and East for its fruit and numerous other agricultural products. The timber regions of northern Arizona will find a growing market within its own territory, which has hitherto been inaccessible, and where wagon transportation and long haul freight from the Pacific coast have made the price of lumber almost prohibitive. The mines situated in the intermediate mining region will be enabled to develop to the ultimate of their possibilities, their supplies and timber being drawn from the northern and southern portions of the Territory respectively, and fuel in and ore out being moved at the minimum of cost.

There is no question before the people of Arizona so vital to their existence and the development of the rich and diversified resources of their Territory as that now before them of providing a means of communication with all the markets of the United States, and no line of railway ever projected through a new country gave such assurance of profit to itself and prosperity to the people relying on it, as the Santa Fé, Prescott and Phoenix railway does at this time.

The officers of this company are as follows: F. M. Murphy, president; G. W. Vaughn, vice-president and general manager; F. A. Healey, auditor; C. C. Bowen, secretary and treasurer; F. J. Sarmiento, assistant secretary and treasurer.

Directors: F. M. Murphy, Prescott, Arizona; E. M. Dickey, Chicago, Ill.; G. W. Kretzinger, Chicago, Ill.; C. D. Arms, Youngstown, Ohio; N. K. Fairbank, Chicago, Ill.; C. C. Bowen, Detroit, Michigan; D. M. Ferry, Detroit, Michigan; G. W. Vaughn, Prescott, Arizona; W. C. Bashford, Prescott, Arizona. Executive office, Monadnock Block, Chicago, Ill.



NEW RAILROAD LINES.



W. H. CARLSON,

President San Diego and Phoenix R. R.

**San Diego
and
Phoenix.**

The next connecting link toward the coast is the San Diego and Phoenix railroad, a standard gauge road from the bay of San Diego to Phoenix, Arizona, a distance of 335 miles. It is controlled by two corporations of the same name.

Although both corporations are entirely separate and distinct, one being of California, and the other of Arizona, yet both have a special interest in the general success and welfare of the other, as their interests are mutual. Together they present one of the best railroad propositions before the people of the United States, for by the building of this railroad the great Salt River, Mohawk and Gila valleys of Arizona, and the great New River valley and the Jacumba, Campo and Jamul valleys of California, will ship immense quantities of freight to the bay of San Diego. The freight is on the ground to-day. What will come in the future, by the development resulting from direct communication to Arizona's seaport, will astonish the most sanguine person—yet, the present is bright enough and sufficient, without calculating the great increase which the future will bring. As a local freight road, it will astonish the railroad world as to its great earnings. But it will not stop there, for its passenger earnings will also be immense, for, when completed between San Diego and Yuma, it will be the link which, in connection with the Southern Pacific railroad at Yuma, will form the shortest and most direct overland route connecting the bay

of San Diego with the harbor of Galveston. When completed between Yuma and Phoenix, at the latter place it will be the link which, in connection with the Santa Fé railroad now building southward to Phoenix, will form another transcontinental route which will be the shortest and most direct route from the bay of San Diego to Denver, Chicago and New York. At Phoenix the prospects are excellent that the San Diego and Phoenix railroad will connect with the Rio Grande Southern, which is now building from Denver.

The route of the San Diego and Phoenix railroad from San Diego harbor to Yuma is by the old "Tom Scott" Texas Pacific railroad survey—the shortest and best transcontinental route.

The distance by the present rail route between San Diego and Yuma is 575 miles, while by that of the San Diego and Phoenix Railroad Co. it will be but 375 miles—a saving of 200 miles.

The San Diego and Phoenix Railroad Co. (of California), has already acquired valuable franchises, terminals and privileges along the water-front at both the city of San Diego and National City, besides rights of way towards Yuma, and is rapidly building its railroad.

The San Diego and Phoenix Railroad Co. (of Arizona), is rapidly acquiring valuable franchises, terminals, depot grounds, concessions and rights-of-way from Phoenix to Yuma. The survey has been completed and construction will soon begin east of the Colorado river.

D. B. Robinson of the Santa Fé system recently visited the line of this road accompanied by Marshall Field, N. K. Fairbanks and W. B. Ream of Chicago, who are interested in these lines. The party was unanimous in declaring San Diego the great city of the southwest, and that the future of Arizona and California was assured beyond question, for as Mr. Fairbanks said: "Irrigation is no longer a theory but a demonstrated fact."

Officers of the road at San Diego, California, are: Wm. H. Carlson, president, H. L. Titus, vice-president, and F. H. Dixon, secretary. The directors are D. C. Reed, H. L. Titus, Chas. U. Bell, A. Roberts and H. G. Merrill.

The officers at Phoenix, Arizona, are: Wm. H. Carlson, president, Gen. W. E. Collins, vice-president, F. H. Dixon, secretary. The directors are D. C. Reed, Gen. M. E. Collins, Jas. A. Fleming, Wm. Christy, E. L. Kelner, H. E. Kemp and Hon. H. Story.

Salt Lake to San Diego. The road from Salt Lake to San Diego, is said to now be on its feet and will soon begin active work. This will open up a country that has been looked at with longing eyes by all familiar with Utah and Nevada. That these roads should be pushed with energy at this time and find

the capital to back them is but another proof of what irrigation is doing. Without irrigation there would be no new railroad building talked of on any of these routes.

**Proving
His
Value.**

Attention has been called many times of late to the energetic efforts of Mr. L. H. Taylor in connection with the study of irrigation and kindred subjects. The State of Nevada has produced many able and useful men, and Mr. Taylor is making himself felt among the foremost advocates of her future possibilities. He was born in Texas in 1862 and came to Southern California in 1884. He spent his boyhood on his father's farm, and at the age of 18 began teaching school. After two years he turned his attention to surveying and engineering, gaining a thorough knowledge of the profession through close study and practical work in the field under the guidance of older men. He early made a specialty of irrigation work, and since 1886 has had responsible charge of a number of important works, mainly in California, where his word goes a long way with capitalists, business men and writers.

In the spring of 1892, after looking over the ground carefully and having faith in the future of Nevada, he decided to locate in Reno, proving his good faith by purchasing a pleasant home upon the banks of the Truckee. He was the author of the irrigation bill modeled after the Wyoming law, introduced in the last session of the Legislature. He was the organizer of the movement begun at Los Angeles during the recent Irrigation Congress to secure the next meeting in Nevada. He was later elected secretary of the Nevada Commission and is now engaged in making a study of the water resources of the State for the Commission, and has been placed in charge of the preparation of a pamphlet on the resources of the State, to be used at the Mid-winter Fair.

Nevada is fully awake to the necessity of an enlightened irrigation policy, and there is hardly a doubt but that the Legislature will act next winter, in which event the friends of irrigation in the State propose that Mr. Taylor shall accept the position of State Engineer.

**Birth of
Irrigation
in Kansas.**

The development of irrigation in Kansas has grown from the use of water from an abandoned mill-race, the appendage of a mill that was never built, which was projected to grind a crop of grain that was never grown.

The year 1878 was one of those exceptionally favorable years which periodically smile upon western Kansas, and a wave of immigration filled with people the country about where Garden City now stands, and they seeded thousands of acres to wheat that fall. Landis & Hollinger, an enterprising firm at Sterling,

who had started a branch store at Garden City, began preparations to erect a mill at the latter place to grind the expected wheat crop. The succeeding year proved to be one of those popularly said to contain thirteen months of dry weather. Not an acre of the wheat sown ever was harvested—probably not one per cent. of the seed ever germinated—and the people disappeared as rapidly as they had come the preceding year. The mill project was abandoned, of course, but a part of the race had been made, and 'Squire Worrell, an experienced irrigator, who had resided for some years in California and Colorado, and whose land lay alongside the mill-race, obtained water from it to irrigate a few acres. The crops he produced were a revelation and an inspiration to the few people remaining in the country, who immediately became enthusiastic irrigators. James R. and William D. Fulton, the founders of Garden City, aided by W. H. Armentrout, Levi Wilkinson, John A. Stevens, W. R. Hopkins, J. W. Weeks and others, immediately enlarged the mill-race into an irrigation canal, and other canals were projected and built in rapid succession.

Settlers were attracted, capital became interested, and the fame of irrigation in western Kansas was spread abroad. Prof. Hay has found that as a matter of fact, a small irrigation canal had been made and used by a farmer in the valley of the Smoky, in Wallace county, prior to the beginning at Garden City, and I am under the impression that it is still in use. But it did not produce such results as to attract attention or excite emulation. The Worrell farm at Garden City, on the other hand, became famous. It was for years the example to which prospective irrigators in southwestern Kansas and southeastern Colorado were cited—the Mecca for seekers of information relative to this new feature of agricultural industry. And I may add that no seeker after information ever went away from the Worrell farm unsupplied, unless the proprietor was absent.

**His Good
Work for
Irrigation.**

It is perhaps not too much to say that of the men who have been instrumental in creating faith in irrigation enterprises and giving dignity to irrigation securities, Charles W. Aldrach, of Salt Lake City, stands in the front rank.

In considering a project of this nature, from its inception to its completion, Mr. Aldrach is what may be termed an "all around" irrigationist. There is no branch of the work with which he is not familiar, and up to the present time success has marked his every effort. THE AGE does not believe that in thus giving credit to this one indefatigable worker it is at all detracting from the merits of other prominent irrigation promoters and experts. Mr. Aldrach's ability in this line has been most fully demonstrated. Success-

ful plants of which he has had the management, both in Colorado and Utah, are proof of this assertion. He has familiarized himself with every branch of the business, whether it be in construction work or in financial arrangements. In the West canal builders have the highest regard for his opinion, while in the East investors have every faith in his statements and the propositions he has presented.

Mr. Aldrach has but recently returned to Utah from a most encouraging trip among the investors of the East. He feels that the outlook for irrigation investments is brighter, and says that many investors who have heretofore positively refused to consider anything of the kind are now turning their attention to this form of security.

One of the latest achievements, the success of which is materially due to Mr. Aldrach's ability, is the plant of the Central Utah Land and Irrigation Co., whose canals and lands are located in Millard county, Utah. A splendid system of ditches and a mammoth reservoir have been constructed under his supervision. Extensive crops were raised last year, and Mr. Aldrach has now returned to the scene to go ahead with the spring work. *THE AGE* has kept close watch of the methods which have characterized this gentleman's work in the past, and at this time takes the opportunity to extend its most cordial assurance of coöperation in other enterprises which he may have under consideration for the development of Western America.

If all enterprises had a C. W. Aldrach at the helm, there would be no failures. He is conservative to a great degree, at the same time is an enthusiastic believer in the soundness of irrigation enterprises, and believes it needs only honesty of purpose, close attention and a thorough information of good projects to place them on a good paying basis, and has worked on the theory that there are plenty of good, safe irrigation projects in this country that need developing, and consequently there need be no risks incurred if the doubtful ones are overlooked until time and increased population demand that extra engineering difficulties be overcome and large amounts expended.

Co-operation among Fruit Growers. At the present time California holds primacy as a fruit producing region wholly beyond dispute by any other region of this or any other country on the American continent. While it is probable that there are other sections of our own country, of Australia and South Africa that may some day take equal rank with California, yet at the present time she stands ahead in both variety and quantity of fruits produced. Fruit production in that State has become a leading pursuit, if not *the* leading pursuit. Although California yields nearly forty million bushels of wheat annually,

and digs twelve millions in gold from her mines, yet her fruit interests, as a whole, are constantly gaining on all others. As the production has rapidly increased in recent years, the question of prices and distribution is a live one, and the growers are taking much interest in them in all parts of the State. Co-operative societies have been formed in a number of places, and the results achieved have been so encouraging that the sentiment is rapidly gaining ground. It is now seen by very many of the leading orchardists that associated effort along essentially the same lines is the only rational and business-like way to reach the degree of prosperity in their business which equity and the labor bestowed demands. To this end a mass convention was recently held in San Francisco, at which a plan for a State Fruit Exchange, previously agreed upon by a committee of a former meeting, was submitted and approved.

For the present the State Exchange will be mostly concerned with the handling of dried fruits of various kinds, including prunes and raisins, of which the past year's crop of each was nearly sixty million pounds. The purpose of the Exchange is not to "bull" prices, but to concentrate the fruit and distribute it in a rational way, avoiding the otherwise inevitable competition of growers with each other, when sales are made indiscriminately by individuals in all available markets. In short, the Exchange will strive to act as the balance wheel in the marketing machinery in California. It is expected in time that the State organization will become the acknowledged head of all the local associations, and thus practically regulate the distribution of a great proportion of the fruit crops.

Such organizations should be encouraged in all sections, not only for the marketing of fruit, but other crops as well. There is a quite general feeling among the tillers of the soil that there is far too wide a margin between what the producer receives and what the consumer pays for nearly all crops. Admitting that this is true, nothing save full coöperation among producers is likely to remedy the evil. The question of expense from orchard or farm to the tables of consumers is the great one to be solved. Merely meeting and passing resolutions condemning the railroads and the commission men will do little good. Producers must organize properly, coöperate honestly and expect to put up money when needed to carry their organizations to a victorious issue. It should be remembered that there is a good deal of human nature in most men, and it does not follow that a commission merchant is necessarily dishonest, or that a fruit grower or farmer is always just what he should be. But no organization of men, for business purposes, can succeed without good business management, and farmers and fruit growers should bear these facts in mind. But there is every reason to hope that with

their awakened sense of the great need of joint effort, our farmers and orchardists will be found fully equal to the emergency, and that the local and State associations forming in many parts of the country will be productive of the highest good to the great interests which they represent.

Western Hops.

Hops have proven a valuable crop in the Pacific States during the past year. The California crop is given at about 45,000 to 48,000 bales, and considerable quantities have been sold at 18 cents per pound. One large grower in Yuba county, that State, is reported to have grown the extraordinary crop of 307 tons of hops on 205 acres of land, and to have refused an offer of \$110,000 for the crop. Indications now point to a considerable extension of the acreage in hops, not only in California but in Oregon, Washington, Idaho, Colorado and some other of the mountain States.

It has been found that the average yield of hops on the Pacific coast is much greater per acre than in the hop-growing States of the East. For example, California shows nearly twice the average yield of New York and Wisconsin, and the yards of Oregon and Washington fall but little behind California in the bounty of their harvest.

The Pecos Valley.

As a valuable object lesson in irrigation, attention is called to the remarkable progress made during the past few years in the Pecos valley, New Mexico. In a late report by the governor of that Territory occurs the following remarkable statement: "The Pecos Valley enterprise boasts the best and most extensive system of irrigation extant on the continent. Five years ago this valley was a barren plain, occupied by a few cattle-raisers. To-day it is one of the most prosperous farming regions of the West, with a population of 17,000 souls and two flourishing towns."

To those who have traveled over the section referred to, and also throughout the arid regions to the west and north, it is evident that what has been wrought out in so short a time in the Pecos valley may be accomplished in a hundred other places having equal advantages of soil, climate, water and availability. Under irrigation it requires but a brief time to accomplish what is only achieved after years of toil and waiting in other less favored regions. In sober truth it may be said that the arid belt to-day is the most promising section of the United States.

Right to the Use of Water.

A number of correspondents have written to us recently asking for a legal opinion as to the right to use water. We take pleasure in answering by publishing, elsewhere, the opinion of Jas. M. Kerr, of 50 Broadway, New York. The judge is one of the best posted men on irrigation law in the East, and his answer will no doubt be read with interest.



MASONIC TEMPLE.

TEMPLE, CHICAGO, ILLINOIS.

THE IRRIGATION AGE is now established permanently in a fine suite of offices in the Masonic Temple, Chicago. Our number is 511, the latch-string is out, and all persons interested in irrigation are invited to call and send their friends to see us.

All communications should be addressed to THE IRRIGATION AGE, 511 MASONIC

Explanations and apologies are always awkward, and disagreeable to make or receive. *The Age Apologizes.* THE AGE advertised two articles for this number which do not appear. Major J. W. Powell, through press of work, was unable to complete his article in time. Prof. Blount sent in an excellent article on "Ideal Methods of Irrigation in New Mexico;" but in accordance with the law of "the total depravity of inanimate things," the manuscript has mysteriously disappeared. This is why the editor, printer and office cat eye each other with suspicion and why THE AGE apologizes.

Our Utah Cuts

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California Winter Exposition.

It was a bold suggestion, that of a great international exposition to be held away on the western rim of the continent, and to follow directly upon the heels of the greatest exposition which the world has ever known, the World's Columbian Exposition, at Chicago.

Without going into the details of its inception, it may be truthfully said that for boldness of design and promptness of execution, the California Mid-winter Fair, as it is popularly called, has never been equaled along the same lines.

Not a dollar of aid has been received or asked from the United States or from the State of California; yet buildings have been erected costing over \$600,000. Exhibits from all parts of California, and from many foreign countries installed, and all in the incredibly

short space of six months. When the first shovelful of earth was turned on the 24th of June last, the site chosen for the Fair was practically a wilderness of sage brush and sand dunes, as uninviting as a desert. When one now looks upon the hundred or more beautiful structures, some of them gigantic, many of them palatial, all of them attractive, the mind is lost in astonishment, and in admiration of the courage, energy and generosity which have made possible the transformation of this wilderness in the Golden Gate Park enclosure to a most beautiful, picturesque and captivating nook of fairyland. Nearly 160 acres are now occupied by the buildings which were originally designed to cover but a limited space, and the brush patch of last summer is now the Cream city of the Golden Gate. The architecture is of the most pleasing type, and a distinct improvement upon the White City by the great lake are the creamy tints that rest the eye and appeal to the taste of visitors. The wealth of palms and other semi-tropic plants added to the flowers that bloom perennially make the picture one of transcendent and abiding attractiveness. While the displays made by eastern and foreign exhibitors are liberal, taste-

ful and pleasing to a high degree, it is after all these features which are distinctively Californian that have proven the drawing cards thus far.

The marvelous results obtained in that State from the cultivation of a soil for years regarded as sterile have attracted the widest attention. Her wonderful displays at Chicago have turned all eyes upon California, and the Mid-winter Fair will confirm the impressions there received by thousands who will come to see California at home after having caught a glimpse of the hem of her golden robes at Chicago. Readers of *THE IRRIGATION AGE* will be at once struck with the important part which irrigation has performed, when examining the varied and remarkable products of the soil of California. From those sections of the State where it is still claimed that irrigation is not necessary to the best results in agriculture or horticulture, the exhibitors have been very careful

to proclaim that fact. Creditable products raised without irrigation are invariably placarded in large letters with that announcement. No such notice is deemed necessary regarding the wonderful products grown on irrigated land, for such results are looked for and expected. No higher tribute than to the value of irrigation as a factor in California soil tillage could be paid than to mark distinctly and draw especial attention to these products not so grown. While it is certain that in many favored localities in California crops of various kinds, including several varieties of fruit, may be grown without irrigation, yet in many places formerly deemed to enjoy these peculiar advantages, it is now discovered that artificial means of supplementing the annual rainfall have proven profitable, though acquired at great expense. This is in reality but saying that however well a favored section may do without irrigation, it will generally be greatly improved with irrigating facilities. Especially is this

true of the production of fruits for which California is so justly celebrated and which are shown in such profusion and excellence at the Mid-winter Fair. Not every one of the 57 counties in the State is represented at



the Fair, but most of the prominent fruit growing counties are there in force with an astonishing line of products. Several large, fine buildings have been erected for the displays of single counties, while in other cases immense structures of a high type of architectural excellence house grand exhibits of a number of counties, each being allotted a given space. These several buildings are stored with a wealth and variety of products unsurpassed by any other section of the globe, if indeed they are equaled or even approached elsewhere. Oranges, lemons, apples just from the trees, and peaches, apricots, cherries, plums, olives, figs and berries of every kind are flanked on one side by massive pumpkins and cornstalks and on the other by a ton of gold bearing rock or a dozen flasks of quicksilver, all the products of the same county, often of a single township.

AVAILABLE WATER SUPPLIES.

By F. H. NEWELL, OF THE UNITED STATES GEOLOGICAL SURVEY.

IN the February number of *THE IRRIGATION AGE*, Major Powell has discussed the water supplies of the arid region, and has drawn some general conclusions as to the amount of water available and its distribution. His article is illustrated by two large maps of the United States, which show in graphic form the average distribution of rainfall, and the average distribution of that portion of the rainfall which flows off of the ground to form streams of comparatively permanent character. The matter is of such general importance that it may be of interest to enter more fully into a discussion of the data upon which these maps are based, and to answer certain queries that have arisen regarding them.

THE RAINFALL MAP.

The rainfall map, as shown by its title, was prepared by Henry Gannett, Geographer of the U. S. Geological Survey and of the Eleventh Census, from observations made and published by the Weather Bureau. This map differs somewhat in general appearance from similar maps issued by the Weather Bureau, in that more weight is given to the topography of the country and its probable effect upon the quantity of precipitation. In the earlier maps, at least, prepared by the Weather Bureau, little if any account was placed upon the existence of mountain ranges or inequalities of the ground. By drawing general lines connecting individual observations, these maps showed simply the areas within which stations giving a certain result were located, as it was probably considered that this would be less misleading than the attempt to introduce facts which were not clearly known by the compilers. This method has its defenders, and is undoubtedly entitled to careful consideration; but where the observations are very widely scattered, as they are in many parts of the West, it has sometimes happened that the maps apparently show similar conditions of precipitation prevailing across a great mountain range as that of the Sierra Nevadas, whereas persons acquainted with the region know well that this is impossible, and that there is a far greater precipitation near the summits than on the lower grounds. In the preparation of the present map, therefore, while all the observed facts have been used, allowance has been made for those areas where there are no records but where, from a consideration of the topography, it is safe to assume that the precipitation is large or small. In other words, reasoning from known data of a given locality, assumptions are made for the probable conditions in localities of similar altitude and position.

A glance at this map shows that the heaviest rain falls of the United States are on opposite sides of the continent, being along the southeastern coast and the northwestern border, the quantity varying on one side from 60 to 70 inches near the Gulf of Mexico and in the highest parts of the Appalachian range, and on the other side from 70 inches upwards, this being along the coast of Oregon and Washington. There is a wide difference, however, in the areal extent of heavy precipitation in these extreme regions. In the southwest the rainfall of 50 inches and over covers an area of many thousand square miles, extending from Louisiana northeasterly along the Appalachians and the Atlantic coast nearly to Pennsylvania; while in the northwest the area of heavy precipitation, or of 50 inches and upwards, is confined to a narrow belt along the ocean and to an equally narrow strip along the summits of the Cascades, also extending southerly along the Sierra Nevadas.

On the printed map to which reference is made the rainfall figures cannot be clearly distinguished except after patient search. The shading of the map indicates, however, that inland from the Atlantic ocean and Gulf of Mexico the rainfall decreases gradually, being from 40 to 50 inches in the lower part of the Ohio valley and the adjacent regions, from 30 to 40 inches in the upper Mississippi and lower Missouri basins, and from 20 to 30 inches in the strip of country extending from Minnesota to southern Texas. Taking the 97th meridian as dividing the United States into about equal portions, it may be said that the country to the east of this receives 30 inches and upwards of rainfall, while on the west it receives far less except where high mountain summits or the coasts introduce modifying conditions. As shown by the map the greater part of the area west of the 97th meridian receives from 10 to 20 inches in depth of rain, a few mountain masses receiving from 20 to 30 inches, while the greater part of Nevada and portions of Arizona and Southern California receive less than 10 inches of precipitation annually.

DATA FOR RAINFALL MAP.

For the construction of a rainfall map of the eastern half of the United States there is abundance of data, there being, as a rule, one or two places in every county where the depth of rainfall has been observed for a number of years. But in the western half of the United States, with the exception of California, there are comparatively few stations which have a record of more than two or three years. There has been lately a great increase in the number of stations



FIG. 1.—RELATIVE POSITIONS OF RAINFALL STATIONS.

The amount of precipitation is indicated by the diameter of the circles.

throughout the West where the depth of precipitation is being observed, and in a few years it is probable that in each important drainage basin facts concerning rainfall will be available, especially over the agricultural areas and in the vicinity of towns. There is still great need, however, of more stations in the higher valleys and upon or among the peaks from which the important streams receive their water supply. Until more high stations are established and maintained continuously, for a number of years, it will be impossible to do more than guess at the depth of rain and snow falling upon the higher summits.

The accompanying diagram, figure 1, shows the relative location of stations from which data concerning the depth of rainfall were obtained for the year 1890.

The circles in this map, figure 1, show not only the relative location of the points of observation, but by their diameter indicate the relative quantity of precipitation. From this it can be seen at a glance that while the eastern portions of Kansas, Nebraska and Texas and the western portion of California were well covered, in the intermediate areas there were comparatively few observations, spots as large in size as the New England States being without a single local-

ity where observations were maintained continuously for a year. A study of the size of these dots shows a wide divergence in the recorded rainfall for adjacent localities, this difference being due, in many instances, to difference in altitude or location of the gauge. The small amount of rainfall through Colorado, New Mexico, Arizona, and other divisions of the arid regions, is indicated by the small size of the dots, these being scarcely perceptible on this scale.

In consulting any map of rainfall similar to the one first mentioned, it should not be forgotten that this represents only the average conditions for the past few years or decades, and cannot in the nature of things tell the whole story of the great fluctuations which take place, not only from month to month, but from year to year. To illustrate these would require a volume. At this time, however, it may be allowable to introduce a few general figures showing the variations which have taken place for ten years. The following table gives the average rainfall at all the stations in the western part of the United States, at which full sets of observations were made continuously.

Average precipitation in western United States, including both arid and humid areas:

Year.	Depth in inches.	Per cent. in average.
1880	20.6	103.0
1881	18.1	90.0
1882	18.0	90.0
1883	17.2	86.0
1884	25.2	126.0
1885	19.2	96.0
1886	18.7	93.0
1887	19.5	97.0
1888	20.0	100.0
1889	23.9	119.0
Average	20.0	100.0

From the above table it appears that the ten years' average rainfall at all of the important stations in the western half of the United States was 20.0 inches, and that there has been a variation of from 86 to 126 per cent. At any one station this variation would have been far greater, but the point to be emphasized is that even taking all stations there are wide differences, one year with another. Thus a map of average conditions must be used very cautiously in any but general discussions. To illustrate, it may be said that any proposition of irrigation, or storage, based upon considerations of average rainfall, is apt to be misleading, as the vital points in such matters are not the averages but the extremes, the greatest and the least rainfalls and their times of occurrence.

The amount of rainfall is a matter, of great importance to farmers in all parts of the country, as well as

to those of the arid region, but to the irrigators and to engineers, or others concerned with the development of the water resources, by canals or by storage, the amount of rain has less immediate interest than the quantity of *run off*. It is only that part of the rain which flows upon the ground which is of possible value in irrigation.

CONSTRUCTION OF RUNOFF MAP.

The runoff, that is to say the quantity of water which flows from the land into the rivers, may be expressed in many different ways, but of these there are two in use, viz: The average quantity per unit of time flowing from a given area; for example, a cubic foot per second per square mile, or by an equivalent depth of water over the drainage basin. This latter has been chosen as the most useful in general discussion, because of the possibility of making immediate comparison with the depth of rainfall. As depth of rainfall is usually expressed in inches, the computation of runoff has been reduced to the same unit. This unit has also another advantage—that comparison can be drawn with data of water supply, which is sometimes also expressed in depth of water over an acre, that is, in acre-inches or acre-feet.

For constructing a map showing runoff, there is far less data available than in the case of a map of the mean annual rainfall, and therefore it has been necessary to make more general assumptions, and to assume wider limits as to the probable runoff from various areas. In the case of the rainfall map seven divisions were made—that is, from 0 to 10 inches, from 10 to 20 inches, from 20 to 30 and so on up to 70 inches and over. In the case of the runoff map only five divisions were taken, viz: 0 to 2 inches, 2 to 5 inches, 5 to 10 inches, 10 to 20 inches and 20 inches and upwards. These figures have been placed upon the map in the February number of *THE IRRIGATION AGE*, but owing to the large reduction they are to be seen with difficulty. In general it may be said that this map resembles that of the mean annual rainfall in that, as might be expected, the heaviest runoff is in the southeastern and eastern portions of the United States and near the northwestern coast, where the rainfall is greatest. The decrease of runoff, however, is by no means proportional to the decrease of rainfall, as will be discussed later.

The facts upon which this runoff map is based were obtained from all possible sources, measurements made by the Geological Survey being tabulated with those had from the reports of the army engineers of the Hayden, Wheeler and other surveys and of various State Engineers and investigators of water sources and water powers. The work of assembling these upon a common basis has been a matter of many years' patient labor on the part

of the Hydrographic Division of the Geological Survey.*

The runoff map is intended to show at a glance the wide difference in condition between the rivers and creeks of different portions of the United States. It is obviously impossible to show minute details, but it is none the less important to those considering the resources of different parts of the country to have broad views concerning the physical conditions. These the map attempts to give, and doubtless does, when one looks at it from that standpoint. It is to be hoped that in the future more detailed facts will be obtained, and that this preliminary sketch may be improved here and there until every locality is shown with great exactness.

As far as possible, data have been obtained for each drainage basin, but there are large areas for which it is impossible to obtain more than crude estimates. The need of more extensive work in ascertaining the exact quantity of water available in each stream, both east and west, is being more generally appreciated, and it is hoped that within a few years the different States, and possibly the United States, may take up this investigation and maintain it continuously on a more extended scale. The results obtained by the State Engineers of California and Colorado, the U. S. Geological Survey, the State Geologist of New Jersey, and by other officials, have demonstrated that investigations of this kind can be carried on to reach definite ends at comparatively moderate expenditures.

DATA FOR RUN-OFF MAP, EASTERN HALF.

In order to bring out more clearly the strength or weakness of this graphic presentation of water supply, the following figures are introduced, these being condensed from voluminous computations of daily and monthly discharge. First will be given the mean annual discharge in depths in inches over the basins of the Connecticut, Potomac and Savannah rivers, these being representative of the heavily shaded portion of the runoff map, marked 20 inches and upwards, and covering the eastern and south-eastern part of the United States.

The figures for the Ohio, upper Mississippi and Missouri basins are not yet reduced to compact form; but in general it may be said that the runoff from the basin of the Ohio river is taken at about 25 inches, that of the upper Mississippi at 12 inches, and

Depth of annual runoff from three large rivers of eastern United States:

Year.	Connecticut, inches.	Potomac, inches.	Savannah, inches.
1872	26.41	....	....
1873	30.62	....	....
1874	30.81	....	....
1875	23.95	....	....
1876	29.15	....	....
1877	22.09	....	....
1878	27.51	....	....
1879	24.91	....	....
1880	18.25	....	....
1881	23.88	....	....
1884	27.30	....	19.84
1885	23.45	....	18.27
1886	....	15.30	23.41
1887	....	14.50	18.14
1888	....	18.83	31.07
1889	....	37.06	23.02
1890	....	26.13	16.26
1891	....	32.57	25.66
1892	....	17.37	....
1893	....	18.45	....
Average,	25.69	22.53	21.95

Computations by Cyrus C. Babb, in Transactions of American Society of Civil Engineers, Vol. XXVII, et seq.

of the Missouri at 3 inches. A comparison of these three great rivers which unite to form the lower Mississippi shows that the Ohio, draining the smallest area, discharges by far the most water; the Mississippi, draining a larger area, discharges less; and the Missouri, from an enormous basin, carries down comparatively little water, so that, per square mile of area drained, the quantity is only about one-eighth or even one-tenth of that from the Ohio basin.

The above facts illustrate the futility of suggestions seriously made even lately, and upon the floor of Congress. It has been urged that storage of the flood waters of tributaries of the Mississippi, rising in the Rocky mountains, would not only be of benefit to irrigation but would diminish the disastrous floods of the lower Mississippi valley. A study of the data, however, such as given above, brings out the fact that the flood waters from the Rocky mountains are insignificant in relative proportion to those from the Ohio and other tributaries. Further than this, they usually come at another time of year and cannot be said to have any perceptible influence on the destructive floods in the States of Arkansas, Mississippi and Louisiana.

* Attention should be called to the fact that the title of the map referred to is in error, the mistake probably arising while in the hands of the printer from its similarity to the rainfall map prepared by Mr. Gannett.



FIG. 2.--DRAINAGE BASINS.

From which the run-off has been measured by the Geological Survey.

A few figures obtained for tributaries of the upper Mississippi will serve to show the intermediate position which these hold between the heavy runoff of the East and the almost insignificant quantity of the West.

Depth of runoff in upper Mississippi basin:

Mississippi at St. Paul,	9.0 inches.
Crow Wing,	12.0 "
St. Croix,	16.0 "

DATA FOR RUNOFF MAP, WESTERN HALF.

The accompanying map, Fig. 2, of the western portion of the United States, shows diagrammatically the areas for which data have been obtained concerning the mean annual runoff for from one to five years. It enables the observer to see at a glance the relative proportion of the localities for which the runoff is known, and to make comparison with those places where it has been necessary to assume similar conditions.

The following table gives the years and depth of runoff in inches, and from this a more definite knowledge can be gained as to the amount of water coming from the particular areas indicated upon this map by the cross-hatching.

RELATION BETWEEN RAINFALL AND RUNOFF.

A comparison of the two maps of mean annual rainfall and runoff waters shows, as previously

Depth of annual runoff from drainage basins within the arid region:

RUN.	STATE.	1890	1891	1892	1893	Average
		Inches.	Inches.	Inches.	Inches.	Inches.
W. Gallatin....	Mont.	13.9	14.1	18.0	.....	15.3
Madison	"	13.5	12.2	12.0	.....	12.6
Missouri	"	3.3	4.3	.....	.....	3.8
Yellowstone	"	16.1	12.2	16.2	.....	14.8
Arkansas	"	3.9	4.5	4.0	.....	4.1
Rio Grande.....	Col.	12.1	13.6	7.9	6.9	10.1
Rio Grande.....	N. M.	2.8	3.6	2.4	.....	2.9
Rio Grande.....	Texas.	0.6	1.2	0.6	.....	0.8
Gila.....	Ariz.	0.5	.....	.....	.....	0.5
East Carson	Nevada	31.9	20.3	20.1	27.7	25.0
West Carson	"	40.1	24.9	.....	.....	32.5
Bear	Idaho.	5.3	3.7	4.6	4.4	4.5
Bear	Utah.	6.7	4.2	4.8	4.4	5.0
Weber	"	9.1	7.5	7.7	.....	8.1
American Fork	"	30.0	.....	.....	.....	30.0
Provo	"	12.1	10.7	10.0	11.3	11.0
Seviere	"	1.5	1.3	1.0	0.9	1.2
Henry	Idaho.	25.2	.....	.....	.....	25.2
Falls	"	27.1	17.8	.....	.....	22.5
Teton	"	14.4	9.7	15.3	.....	13.1
Snake	"	14.4	.....	13.5	10.4	12.8
Owyhu.....	Oregon	2.5	1.8	4.5	3.1	4.0

noted, that the runoff is not absolutely dependent upon the quantity of rain. It is the result not only of the depth and distribution of precipitation, but also of the character of the topography. That is to say, the amount of water which flows off the ground is influenced as much or more by the slope of the surface than by the quantity of water or by the time during which it falls. There are other modifying circumstances, but these two are so much more important that they should be dwelt upon. In consideration of the water available, it is often assumed that much study should be given to the rainfall, especially when it is desired to secure a supply of water by means of reservoirs. It must be remembered, however, that reservoirs do not catch the rainfall except to an insignificant extent. They receive, not the water which falls as rain, but that which flows off of the ground and for a time at least forms streams or rivers; and therefore far more attention should be paid to the water while flowing than to the quantity which may occur as rain or snow.

It is well known that more water comes from high mountains than from plateaus, although the depth of rainfall upon these may be nearly equal. But it is not always as clearly recognized that as the rainfall upon these high plateaus and mountains decreases, the quantity of water from the nearly level places becomes far less proportionally than from the steeper slopes. In the following diagram an attempt is made to show graphically the relation of the depth of rainfall to depth of runoff upon the steeper slopes and upon those more undulating or nearly level. In this diagram the vertical lines indicate the mean annual depth of runoff in inches and the horizontal lines the

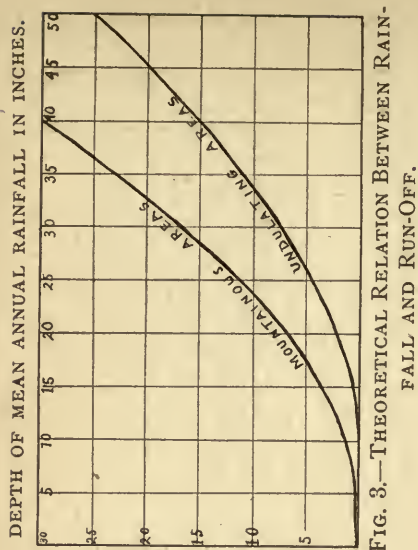


FIG. 3.—THEORETICAL RELATION BETWEEN RAIN-FALL AND RUN-OFF.

DEPTH OF MEAN ANNUAL RUN-OFF IN INCHES.

mean annual depth of rainfall. The two curved lines show the conditions, the upper one for the high mountain regions, the lower for the more gentle hill slopes and rolling plains. Taking for example the mean annual rainfall, of 40 inches, it has been found that in high mountains the runoff may be expected to be as much as 30 inches, while on undulating country the runoff will be more nearly 15 inches. With a rainfall of 25 inches the runoff from high mountains may be about 12 inches, and from the lower plains less than 5 inches; while with only 10 inches rainfall the runoff from mountains is less than 2 inches and from plains practically nothing. In other words, by following along the upper curve the approximate runoff corresponding to a given rainfall in mountains can be obtained, while by taking the lower curve the similar relation upon surfaces of less slope is shown. These curves are somewhat arbitrary, and the values actually obtained from observation might go beyond them; but they express this broad fact, viz: That with decrease of rainfall upon any given area there is a far greater decrease of water available.

FLUCTUATIONS OF STREAMS.

It must not be supposed from studying these maps and diagrams that the run-off is a certain invariable quantity any more than is the rainfall. The rivers fluctuate within wide limits, perhaps three or four times as much water coming in one year as in the preceding or succeeding year. The figures and diagrams deal solely with averages, and it must be borne in mind at all times that while averages are useful for obtaining broad views, there is never in nature any such thing as an average year any more than there is

an average man. To illustrate the wide variation in quantities of water at different times of the year, as well as the enormous differences in rivers themselves, the following diagrams have been introduced, showing a number of large rivers, both east and west. Diagram No. 4 gives the maximum, minimum and average quantities of water in the Connecticut, Potomac and Savannah rivers of the east, in comparison with tributaries of the Mississippi and a few streams of the west. On this diagram the length of the horizontal bar or block indicates the quantity of water flowing in the river, whose name appears at the left. The solid black, by its length, shows the least flow, the black and shaded the average, and the open portion, combined with the other two parts, the greatest flood.

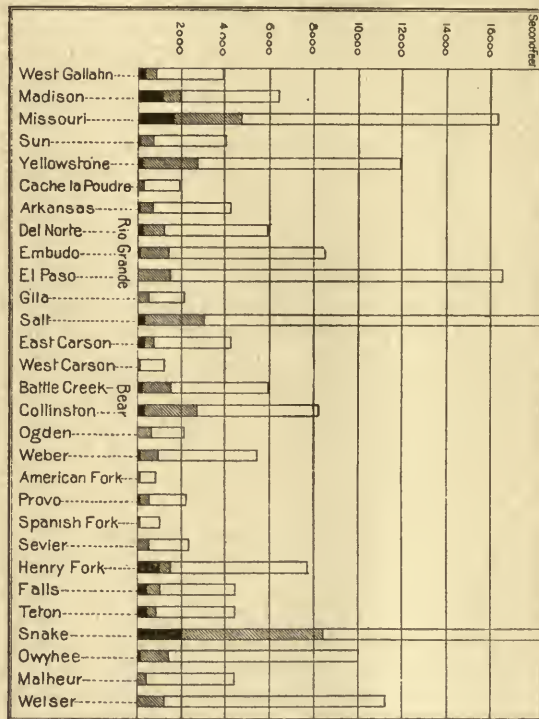


FIG. 5.—MAXIMUM, MINIMUM AND MEAN DISCHARGE OF WESTERN RIVERS.

In the case of the river at the top of the diagram the upper Missouri in Montana, even in flood, it is so small that it can scarcely be seen on this scale. The Snake river, of Idaho, makes a better showing, but its average discharge is scarcely perceptible. The great flood of Salt river, Arizona, occurring in February, 1891, appears at about 300,000 second feet, but the average discharge of this stream is too small to be seen. The Sacramento stands comparison with the

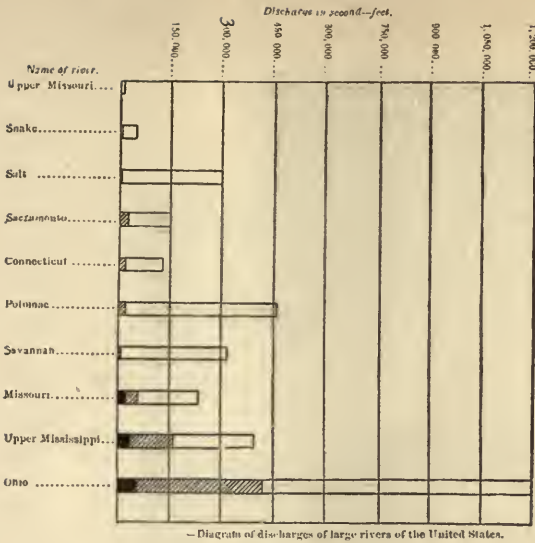


Diagram of discharges of large rivers of the United States.

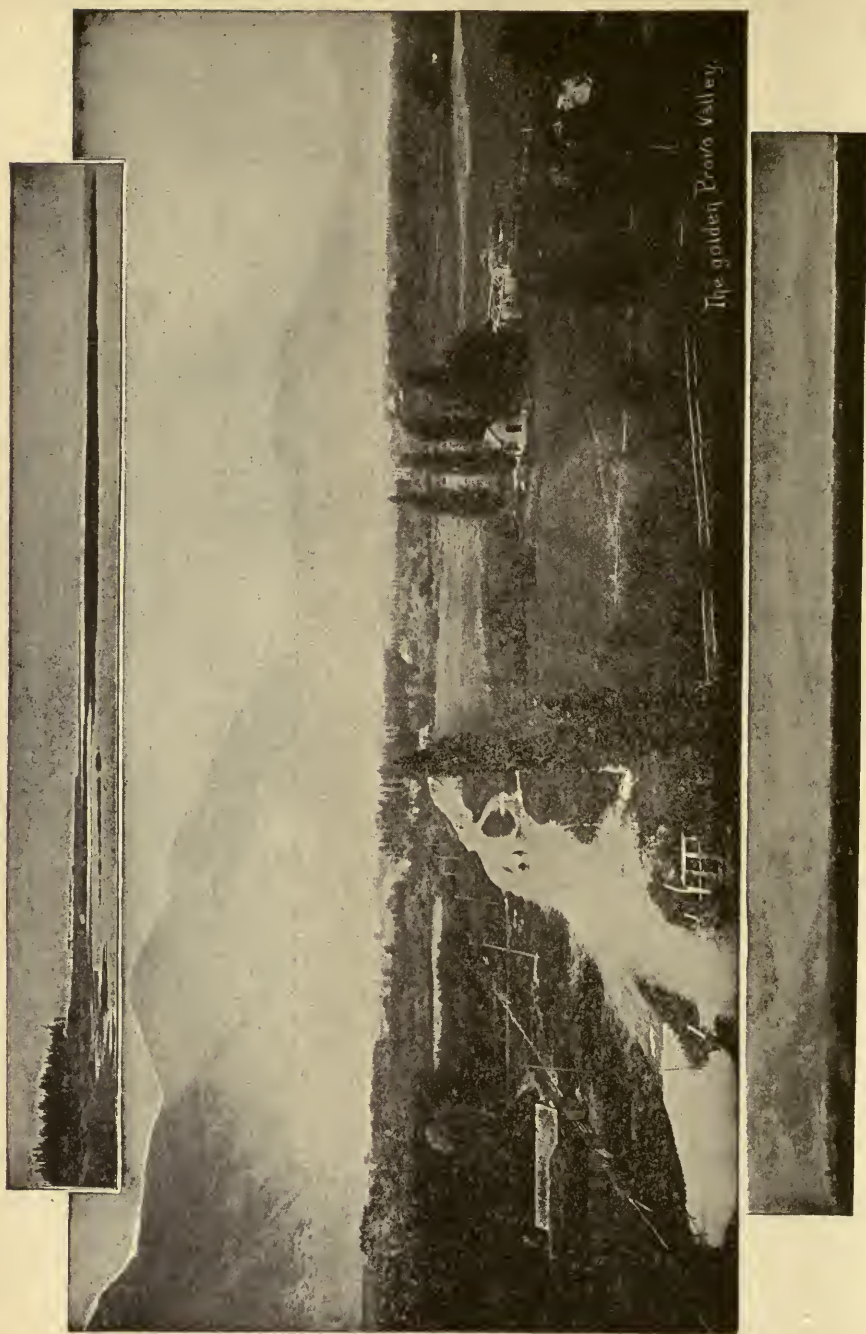
Fig. 4.

Connecticut and with the Potomac in average discharge, but is far below the latter in maximum flood. The last three lines of the diagram show the relative size of the Missouri, upper Mississippi and Ohio, previously discussed. It is apparent from this diagram that the flood of the upper Mississippi does not reach the average discharge of the Ohio, while the flood of the Missouri is not much greater than the average flow of the upper Mississippi.

The relative size of the rivers of the west cannot be shown on the diagram just mentioned, and therefore a different scale has been chosen for diagram, figure 5. In this case, as in the other diagram, figure 4, the black portions of the bar indicate the minimum discharge, the shaded portions, including the black, show the average and the open portions, including the black and shaded, give the maximum discharge. The width of the diagram allows only about 17,000 second feet, and in two cases, those of Salt and Snake rivers, the diagram is incomplete as regards the flood, this being shown in full upon figure 4 just described. A comparison of these lines brings out the difference in quantities of water in the streams better than any figures. The basins from which this water comes are indicated upon the map, figure 2, which also shows the approximate size of the basins and the places where measurements were made.



Peaceful Plains.



THE GOLDEN PROVO VALLEY, UTAH.

AMERICAN AND INDIAN IRRIGATION WORKS.

By H. M. WILSON.

THE development of the scientific practice of irrigation engineering in this country is a thing of to-day. It can scarcely be said that fourteen years ago there existed a single irrigation work of magnitude designed on sound engineering principles. The art of American irrigation engineering has only been developed within the past decade, while most of the more modern and creditable works are but approaching completion.

Like everything which Americans undertake, now that they have really begun the development of their irrigation resources, they are bringing to bear upon it their proverbial push and energy, and the advance made in the number and magnitude of works under construction is only keeping pace with the skill and intelligence displayed by engineers in overcoming difficulties and developing the science of American irrigation engineering. The changes wrought in the practice of this science in the past few years are astounding. There are under construction to-day numerous irrigation works, both for the utilization of the perennial flow of streams by direct diversion and for saving the storm flow of intermittent streams by means of storage. There are completed or under construction a dozen canals with capacities varying from one thousand to two thousand second feet, with bed widths of from fifty to seventy feet, and the lengths of the main lines of which are from fifty to one hundred miles, with as many more miles of laterals and distributaries. Such canals will irrigate from one hundred thousand to one hundred and fifty thousand acres each, and will render habitable twice that area, each affording on an average of forty acres to a farm, homes and support for fifteen thousand people. Of storage reservoirs there are a half dozen completed or under construction, which will impound from one thousand to three hundred thousand acre-feet each, or sufficient to irrigate and reclaim more than half that many acres of land.

The irrigation works of the United States are second in importance to those of no other country in the world, and, while not of such magnitude as those of India, compare very favorably with them in mode of construction. The area of land commanded by works completed or under construction is second only to that in India, and, excepting the Cavour canal in Italy, there is no work of this kind in Europe which compares in size with our modern canals.

ESSENTIAL POINTS OF DIFFERENCE.

There are six essential points of difference between the irrigation works of this country and those of

India. The first relates to ownership and legislation; the second to the character and mode of life of the people who inhabit the two countries; the third to the climatology; the fourth to engineering; the fifth construction; and the sixth and last to superintendence and maintenance.

The first point of difference is dependent chiefly on the fact that in India all land and all water belong to the government, and that the irrigation works are designed, constructed and maintained by the government. In consequence of this the legal questions involved are comparatively few and relate chiefly to the amounts of water to be distributed to consumers and the right of way through improved land. The question of profit is not always paramount, and while the direct money return is often small, the indirect return to the government is always large in enhanced revenue from the rental of land, in immunity from famine (and the consequent heavy drain on the treasury for relief and charity), and in the general benefit to the people resulting from increased resources and exports. While the people of the United States or the general government are benefited as is the government of India from the last cause, the owner of the irrigation works is not directly, as he is invariably a private individual or a corporation. As the irrigated lands are all under private ownership, and the water the property of the public until appropriated, the owners of irrigation works do not benefit by enhanced land values unless they purchase and own land. The priority of right to appropriate water and the ownership thereof give rise to some of the most troublesome and expensive legal complications with which the Western people have to deal. In this country the laws relating to the ownership of irrigable lands and works, and rights of way have become so voluminous and differ so greatly in the various states as to create one of the most serious impediments to the inception of irrigation enterprises. Direct money profit is essential to any irrigation project in this country, and in our most successful works this profit has as yet been chiefly realized from the sale and ownership of land, the value of which has been increased by furnishing it with a water supply, rather than from the sale of the water developed by the project.

IGNORANCE AND POVERTY.

The second point of difference referred to is a result of the ignorance and poverty of the agriculturalists of India as compared with those of the United States. A large proportion of the cultivated land of India is irrigated by water raised from wells. This is not

pumped, as is generally assumed in this country, by means of windmills or steam power, but it is lifted laboriously, a small bucketful at a time, by means of the well-sweep, so familiar in the eastern portions of this country, or by means of cattle, which raise the water from the wells by a rope and windlass. The volumes of water raised by such processes are so small that they must be handled with the greatest care in order that they shall reach the lands without being wholly absorbed in the conveying ditches, while the laborers who perform the work are content to receive as wages from two to six cents per day. By such processes a family of two or three men and as many women raise on from two to five acres of land sufficient produce to support them throughout the year. It is unnecessary to compare such rates of wages and such a mode of life with that lived by the inhabitants of our country. The patience, care and penury exercised by these simple orientals, which enables them to eke a satisfactory existence out of such labor and wages, will never be practiced by American farmers, and will, therefore, never enable us to develop and utilize many of the minor water resources of the country which aid in making the cultivation on the semi-arid lands of India so generally productive.

CLIMATE.

A third of the essential points of difference in the practice of irrigation in America and India is in the climate of the two countries. In India there is no cold season as in the United States. Winter and summer are not distinguished by hot and cold weather, for it is always warm there, the winter months being quite as warm as the summer months are in the most of our arid West; but they are recognized by the difference in rainfall during the two seasons, and thus the year is divided into a wet season and a dry season. During the wet or monsoon period, which occupies several of the summer months, the rainfall is so great and the temperature so high that nearly all the products of tropic and semi-tropic vegetation can be grown in rank profusion without the aid of irrigation. While this statement is not generally true of the whole of India, it applies to the more highly irrigated and cultivated portions—the great Gangetan plain, which lies immediately south of the Himalayas, and in which are located most of the celebrated canals of the country, and to western Madras. Throughout the country in which are located the Ganges, Jumna, Sirhind, Soane and other great canals, the average annual rainfall ranges between twenty-five and forty inches, while the same average amount falls on most of the Presidency of Madras, where are built the Godaveri, Cauveri, Orissa and similar great deltaic canals. It is in the dry season that irrigation is chiefly practiced in India. Though

the rainfall amounts to but a few inches, chiefly occurring in violent storms, at that season the products cultivated consist of those having the highest commercial value, as wheat, cotton and sugar cane. As a result of this high precipitation, it will be readily appreciated that the rivers from which the irrigating waters are derived are well supplied with water, and are able to furnish a far greater abundance of this for the supply of canals than is furnished by catchment basins of similar areas in this country. This fact has an important bearing upon the design and construction of the irrigation works of the two countries, and naturally influences the magnitude and permanence of such works.

ENGINEERING.

The fourth point of difference referred to is that of engineering. The character of Indian rivers and their relations to the irrigable lands is such that the canals taken from them rarely require long or difficult diversion lines to bring the water to the lands. The chief engineering difficulties encountered are in constructing stable weirs and headworks in the sandy river beds, and in contending against the enormous flood discharges of those rivers. In most portions of our country, good firm rock, or heavy gravel and clay soils can be found, in which to locate headworks. Here also the relation of the streams to the irrigable lands is generally such that long and difficult diversion lines have to be constructed before the water becomes available. In other words, the chief skill of the Indian engineer is required in locating and constructing the headworks; that of the American engineer in building the first ten or twenty miles of the canal line.

HASTE AND CHEAPNESS.

The fifth point of difference, which is of a structural nature, is chiefly due to the haste demanded and the cheapness required in the first cost of constructing these works. In India the works are built by the Government, and are accordingly designed with a view of making them so permanent that they will last almost forever, and that the charges for maintenance and repairs shall be a minimum. To this end all irrigation projects are carefully thought out and surveyed and resurveyed, until the best possible location has been chosen and the details of the scheme perfectly elaborated. The weirs, headworks, aqueducts and regulating gates are all constructed of the most substantial masonry, and the repairs to such works are reduced to a minimum. With us the main object is to reduce the first cost to the lowest possible figure, in order that the works may be completed quickly and cheaply, and the investors begin to derive some profit at the earliest possible date. Our diversion weirs have, therefore, generally been constructed of cheap wooden framing, and occasionally, as an un-

usual extravagance, of rock-filled crib work, while many canals, especially in California, are taken directly from the streams by a simple inlet, with no dam or other diversion weir. Little time is spent in ascertaining the best location, either for the head-works or the canal line, and wood is universally employed in the construction of flumes or aqueducts, regulating gates and falls.

The pressure which engineers are now bringing to bear upon the projectors of irrigation works is such that more good, substantial and permanent work is being done than at any time in the past history of irrigation development in this country, and the date is not far distant when our irrigation works will be designed and constructed with the care they deserve. There is even less excuse for faulty and unsafe work on an irrigation system than on a railway; for should a railway bridge be badly constructed and give way, the lives of only those few persons who are upon the train which falls through it are lost, and if the line is badly located the chief loss to the company is in deterioration of the rolling stock and added cost of haulage; but if a dam or a similar work on an irrigation system gives way, not only are the lives of those whom the floods may engulf endangered, but a large amount of property destroyed, and the lack of water for the irrigation of the crops may impoverish and render destitute hundreds of families who are dependent upon the water supply to mature their crops. In addition, the bad location of the canal line and cheap construction of works frequently mean such enormous outlays for repairs and maintenance as to consume all the returns from water rentals and run the company into debt.

MAINTENANCE AND SUPERVISION.

The sixth point of difference referred to between Indian and American irrigation works is in the maintenance and supervision of these works. In India the completion of an irrigation system is no reason for dispensing with the services of the engineers. A chief engineer, with his assistants, who have charge of the various divisions of a canal, is always retained in order to keep the works up and to design and superintend improvements. In addition to the engineer corps are overseers and patrols, the latter having comparatively short sections of the canal, which they walk daily in order to report the condition of the works, make or suggest needed repairs, and especially to perform police duty by preventing damage being done by heedless or vicious persons, and to keep cattle from tramping over the ditches. The superintendence by these engineers and overseers renders it possible to keep the canal up to the highest state of efficiency, and the magisterial and police powers given them enable the canal officials to arrest and punish offenders against canal laws.

With us, after a canal system is completed, the services of the engineer are usually dispensed with, and the supervision and maintenance of the work fall to the lot of some superintendent, who may be a farmer, having no knowledge of engineering and as little of the needs of the work under his charge. Gophers are permitted to burrow at discretion in the canal banks, and small leaks go unattended to, as their dangers are unappreciated, while flumes and weirs and other perishable works are permitted to remain unrepaired until they are past repairing and must be renewed. Rarely is any proper system of patrol in operation; sometimes ditch riders are employed, though usually only on the more dangerous sections of the canal. On the vigilance and skill of the patrolmen and superintendent largely depend the successful operation of a canal system, and this branch of the service is that which is most neglected and least thought of in the administration of American canals.

HIGHEST WEIR IN THE WORLD.

The claim is put forth by Stanislaus county, Cal., of having the highest overflow dam in the world. It is located in the cañon of the Tuolumne river, three miles from the town of La Grange, and, according to the dimensions given, is 360 feet long on top, the plan being curved on a radius of 320 feet, and the maximum height above the foundation is some 128 feet. The front face of the wall is made to conform to the curve described by the water in overflowing and to deflect it into the basin in front of the dam. The dam is built of "cyclopean rubble," and is a model of solidity. Huge rocks, weighing from six to ten tons, were first laid on the bottom, all their projecting portions being cut off, and a flat but rough surface prepared for the lower bed, but before being placed in the bottom all the stones, whatever their size, were scrubbed, and subjected to the action of numerous jets of water under a pressure of some seventy-five feet. The dam is intended to distribute water over a territory embracing 276,000 acres, one district, the Turlock, comprising about 198,000, and the Modesta district 78,000. The water flows from the dam into two ditches, one of 30 miles length and 100 feet width, and the other of 28 miles length and 80 feet width. The lake will be four miles long and one-half mile wide.

Whatcom, Wash., is talking of utilizing a 40-foot fall for the generation of electricity for street cars, lighting, etc.

In the Pecos valley, N. M., they are refusing \$100 an acre for 640 acre tracts of land that three years ago sold for \$1.25 an acre. Moral: cogitate, emigrate, irrigate.

WATER SUPPLY ON THE GREAT PLAINS.

BY ROBERT HAY.

IN a recent issue of THE AGE the editor has indicated that certain statements of Major J. W. Powell, at the Los Angeles Irrigation Congress, were controvertible and would be controverted in the columns of this paper. I, on the contrary, wish to emphasize statements made by Major Powell at the Wichita Convention. So much of the Major's speech at that place was so pertinent to the general question of the water supply of the West that while it expresses what I have been telling for several years, yet the authority of the director of the U. S. Geological Survey caused the interest in his sayings to be great, and I wish it to be continuous: Hence this article. While I cannot quote the words used, I will state briefly a few points made by the Major at Wichita:

1. The rainfall of a drainage area is the sole source of the water supply of that area.

2. There is no perennial supply of underground water apart from the rainfall.

3. The rock formations — limestone, sandstone, gravel, etc.—below the surface are more or less charged with water.

4. If this water is drawn from the underground rocks by springs, artesian or common wells, the supply will give out unless replenished by rainfall.

5. After the underground rocks are filled to saturation, the rainfall of the region is disposed of in only two ways, viz: By evaporation and by *running off* towards the sea.

6. In regions of heavy rainfall (40 inches and upwards), the runoff is half of the precipitation. In regions of scant precipitation (20 inches and under), the *runoff* is diminished to one-tenth of the precipitation. Evaporation disposes, in either case, of all the rest.

These statements are in the main undeniably true. There is only one that for the region of the great plains needs modification. That modification will appear in what follows. It is important, and I believe that Major Powell from his general knowledge of the region east of the Rocky mountains will allow its value in relation to irrigation.

If however these statements are true, and to persons who have studied the subject almost axiomatic (except No. 6), yet to many people interested in the development of the West they need amplification before they are fully understood. We wish them to be understood, for there is a very practical side to this question of the supply of water for irrigation. It matters comparatively little, if a supply of water is found, whether that water originally comes from the clouds or from a water factory in the bowels of the

earth. But while we are *seeking* water it will save much useless labor and expense if we do not work under a false assumption caused by an incorrect theory.

MEANING OF RAINFALL.

By *rainfall* is meant here, as by most writers, *all* the moisture precipitated from the atmosphere upon the earth. *Precipitation* is the better term to use for this totality of rain, snow, hail, sleet and dew. But *rainfall* properly understood is a handier word and seems less technical, so I shall use it.

Then the assertion that the rainfall of a drainage area is the source of the water supply of that area is to be fully understood of a particular region only by knowing what the situation is of the watershed of the region, and where is the final outlet of the *runoff* thereof. The line of a watershed, or "divide," is a very tortuous one. It may follow the rocky ridges of mountain peaks, the highest level of a mountain pass, across the surface of a mountain tarn or marsh, whose waters have an outlet at both ends, or it may be a sinuous trail on a plain that seems perfectly level to the eye. A single drop of water, if preceded and followed by others, might split itself on a pebble or a pinnacle of rock, and one-half go to one ocean and the other half seek an outlet the whole of a continent apart. The last drops of a rain are mostly reclaimed by the atmosphere through evaporation, and generally *all* the drops of a short shower are so reclaimed.

Returning to the fact that the rainfall is the source of the supply of the water for the drainage area it may be well to note a possible exception. That part of the rainfall that soaks into the ground may reach some porous bed that will serve as a storage basin and it will move through the porous bed or beds in the direction of the dip of the strata, to supply any outflow from springs or wells. The dip of the strata does not always conform to the surface topography, so it is possible in such cases that water absorbed by the earth in one drainage area might be discharged by springs or wells in a ravine or plain belonging to another basin.

DAKOTA'S ARTESIAN WELLS.

An illustration of such exception is found in some artesian well regions. For example, the best suggestion is that the magnificent artesian flow of the wells of the James river region of the two Dakotas have their supply from the rainfall on the highly inclined strata of the Black hills or more distant sources up

the Yellowstone and Missouri valleys. Such cases do not, however, controvert the general truth of the proposition that the rainfall of a drainage area or basin is the source of the supply of its water. It will be in favor of brevity if we use the word *basin* as the full equivalent of *drainage area*.

The full significance of the use of the word basin should, however, not be lost sight of, and in some cases it is. It means *all* the land *enclosed by the highest rim* that bounds on every side the valley in which runs the *stream* whose *basin* is under consideration, AND all the subsidiary valleys whose surplus waters naturally find their way into it. Thus the *basin of the Arkansas* has its western water shed among the rugged ridges from north of Pike's Peak to south of the Raton mountains, and its northern water shed is a sinuous line from near Palmer lake across the plains south of the Smoky Hill river and between the Neosho and Marmaton to enclose the head waters of Spring river, and so by the flanks of the Ozarks to the confluence of the Arkansas with the Father of Waters, while the southern divide of this great basin would be a similar line from eastern New Mexico across the Texan Panhandle north of the Red river, and across Oklahoma and the Indian Territory to the mouth of the Arkansas. This includes many smaller basins, some of which as belonging to rivers of the plains, as the Big Sandy, the Medicine, the Neosho, and others, derive no drop of water from the mountains; and others, as the basins of the two Caudins, the Purgatoire (locally *Picketwire*), the Fountain, and the Cimarron, have their highest springs in the high valleys on the flanks of the mountains. The Kaw river basin has no mountain supply. Its subsidiary basins, of the Republican, Smoky Hill, Solomon and Saline, have their supplies all from precipitation east of the 104th meridian—the midregion of the Great Plains. So, too, the Loup rivers and the Running Water of Nebraska.

Think, then, of any great basin, as the Arkansas, or any small basin, as that of the Solomon river, and the truth remains that the rainfall of the basin is the source of the water supply of the basin.

The precipitation—rain, snow or hail—on any given area can readily be followed to its immediate disposition. Suppose the quantity for a year at a given spot as shown by a rain gauge was twenty inches.

WHAT BECOMES OF THE RAINFALL.

What became of it? It was disposed of *immediately* in three ways: (1) Some of it soaked into the earth. This may be called the *seepage*. (2) Some of it *ran off* to lower levels and to the natural drainage channels. (3) Some of it was taken back into the air by *evaporation* from the spot where it fell. The relative proportions of these vary with every down-

fall on the same area and in the same downfall on different areas. On the same area with an inch of rain falling within an hour, the runoff would be large and the seepage comparatively small. The same rainfall spread gently through twenty-four hours would give a large seepage and small runoff. Evaporation would vary with the direction of the wind, and the moisture or siccidity of the atmosphere after the rainfall. On different areas seepage would vary with the porosity of the soil, and thus indirectly would affect the quantity of runoff and evaporation.

There are probably no areas where accurate or even approximate measurements of these three items of the immediate disposition of rainfall have been made. But when we go beyond *immediate* results, the question of seepage may be eliminated from the problem. The water that soaks into the ground is eventually returned to the surface to be *evaporated* on exposed surfaces, or through the pores of plants; or it works downward, and all in excess of the rock saturation below becomes *runoff*, issuing from springs or otherwise. Thus, then, the *ultimate* destination of all rainfall is either *evaporation* or *runoff*, as the saturation of buried strata is practically the same always. If, then, numerous continuous observations give us the *total rainfall* of any basin, and if careful measurement can be made of the outflow of water at the mouth of the main drainage channel, then the measurement of that outflow would give us the total final *runoff* of the region, and the difference of that from the totality of rainfall would be the *totality of evaporation*. Suppose the Kaw river outflow at Kansas City were carefully measured for a year, that *runoff* would be the *excess of rainfall over evaporation* in the whole basin extending into Colorado and Nebraska and having an area of not less than 50,000 square miles. But if at Kansas City there are considerable depths of sand and gravel under the bed of the Kaw and under the bottom land adjacent, which would convey water as underflow to the underflow of the Missouri valley, then measurement is impossible, and the relation of *runoff* to evaporation and rainfall cannot be ascertained. There are valleys where the nature of the rocky bottom of the river bed and the valley itself enables the outflowing runoff to be measured with approximate accuracy. Such measurements have resulted in the statement of proportions of runoff to evaporation given in No. 6 above.

ON THE GREAT PLAINS.

The application of facts observed elsewhere is not easy to the region of the Great Plains. And in connection with the subject of irrigation and the question of how much underground water is recoverable for artificial use, the statement as to the relation of the totality of outflowing runoff to the rainfall of the ba-

sin, if absolutely instead of only approximately correct, is positively misleading. At the point of outflow, if the runoff is only one-tenth of the rainfall of the basin, it is of course impossible to use more than one-tenth *at or below* that point. But that is *not in the basin at all*. The question is: How much water is recoverable and usable in the basin? At least that is the question over large areas of the plains. In considering this problem the division of the *immediate* disposition of the rainfall into three parts, as given in a previous paragraph, must be understood, and the amount of *seepage* as before defined becomes of importance.

SEEPAGE.

It is quite possible, and in many districts highly probable, that the seepage may amount to fully one half of the rainfall and yet the final runoff be not more than a tenth. In the semi-arid regions, the line of saturation of the rocks is some distance below the surface, in some cases over a hundred feet. It follows then that for at least the greater part of the year the surface formations are relatively at least very dry. They are then capable of rapid absorption of water. True, the buffalo-grass sod of wide areas of the prairies is almost like a shingle roof in a rainstorm and the immediate runoff is great, but there are areas where the sod is of different nature or missing altogether, and the surface is highly absorptive. This and the dryness of the subsoil combined make it certain that a large proportion of the seepage goes into depths where it is conserved for some time before being brought to the surface in feeble or strong springs to be again diminished by evaporation. It is important to remember that the drier the atmosphere the more rapid the evaporation. It is just as true that the drier the subsoil the greater the seepage.

It is conceded—it is a matter of repeated observation—that the plowing of the soil, the breaking of the prairie sod on the plains has increased the moisture in the subsoil; that is, the seepage is greater. Yet the *totality* of runoff is probably only temporarily interfered with.

The relatively large seepage in and through dry, porous soils and subsoils in the semi-arid region is a factor to be considered in dealing with the estimate of recoverable water in the shallow basins of the comparatively level regions west of the 100th meridian. The estimate of Prof. Van Diest that for eastern Colorado, probably five inches of rainfall are recoverable from underground, is in my opinion approximately correct, and it will apply to adjoining parts of Nebraska, Kansas and Texas.

I do not know of any series of measurements of runoff on the great plains. But applying the least favorable estimates as in No. 6, *ante*, with the consideration of seepage suggested above, it is certain that given

the mechanical means for raising water, large regions of the plains may be redeemed by irrigation. That is, apart from what may be done on slopes and in valleys the farms on level prairie may have, each of them through extensive regions, enough water to irrigate five, ten or fifteen acres out of the quarter section. On five acres, irrigated, the farmer can live well; on the larger areas, he can accumulate savings year after year, and on the rest of his land he can grow grass or wheat as the seasons allow at present.

There are now hundreds of wells on the high prairies that by all strain yet put on them are inexhaustible. Let them be tested to the limits of irrigable possibilities on their owner's farms, and the store of water underground will, in the writer's belief, be kept up from the rainfall through the medium of seepage on the increasing area of the more absorptive because more highly cultivated land.

IN SOUTHERN CALIFORNIA.

From latest reports in Southern California, some of the oranges have been frozen again this year, the extent of the damage not yet being definitely known. THE AGE has stated before that there are many places in the *supposed* orange belt that do not properly belong to the *real* orange belt, and even some portions of each of the choice orange colonies could be more profitably devoted to the raising of deciduous fruits. When all the lands in California that are frostless shall have been supplied with a good water right, and are set to orange trees which have grown to their full bearing capacity, there will not be more than enough to supply the demand at good prices; but those who engage in this business should be sure that they have the proper location, that the climate as well as the soil and water is well adapted to the production of choice oranges, otherwise other fruits will prove more profitable.

ARROW HEAD RESERVOIR.

A representative of THE AGE visited Cincinnati recently, and while there called at the office of the secretary of the Arrow Head Reservoir Company, who stated that work would commence in early spring on the construction of their works there, and would be pushed through until completed. This is one of the most extensive works of the kind produced, and will prove a profitable investment to its builders, as below this system will be found an immense area of the most valuable land in California that is not supplied with water, and this is about the only system that will be able to supply them. If constructed on an economical and capable basis the construction of this reservoir will prove a blessing to both the water users and the water sellers.

THE RIGHT TO THE USE OF WATER.

BY JAMES A. KERR.

IT is an elementary principle of law that air, light and water are the common property of all mankind; that is, belong to no one in particular, but to the public at large. No man can legally secure a monopoly of either in any given locality or district; neither can he, by purchase or otherwise, acquire a proprietary right in either. *The right to the use* is the only right that can be acquired, and this is not a proprietary right, but simply an easement.

The only method in which any private interest can be secured in either air, light or water is by grant of the sovereign; by long use, which presupposes a grant; or by statute. In this country, private interest in either is secured only by act of Congress, by statutes of the various state legislatures, or by prescription.

While the use of running water may belong to a particular individual, the thing itself—the *corpus* of the water—can never be appropriated. The right to the use of the water is restricted to the reasonable wants of the individual or company, and is held subject to the great fundamental principle of “not interfering with the rights of others.”

In the arid region, water may be filed upon and appropriated for a beneficial public use, and not for a purely private purpose; that is, the persons or company filing upon and appropriating a certain quantity of water acquire a right to the public beneficial use of the water filed upon, and appropriated to the exclusion of all others, in return for certain public benefits conferred. But the rights thus acquired, under statute, are merely an easement in the use of water, and not an ownership thereof. Persons thus filing upon and appropriating water are entitled to its use for a public beneficial purpose, but do not obtain a private ownership thereof¹—they cannot exercise any proprietary right or power over the water itself.

Irrigation canal companies differ in this respect from many other corporations carrying with them a public beneficial use, such as railroad companies, for instance. The reason why canal companies differ from railroads in this respect is because of the difference in the nature of the substances or objects with which they deal. Railroads deal mainly with land, which is subject to private ownership and control, and they secure either an easement in the use of the land, or the title to the land itself by condemnation under the power of eminent domain; while canal companies deal and have to do principally with water, which is not subject to private ownership and con-

trol. But even land cannot be taken by condemnation under the power of eminent domain or otherwise for a purely private purpose: that is, for a purpose that does not carry with it a public beneficial use. Where the public at large has not some interest in the use to be made of the land there can be no condemnation thereof. Thus, a man cannot condemn and take lands of another for his own private use, as for a farm, or residence grounds, or a hotel site, or a private park, although the general public may be interested that he shall have a farm to till or a house to live in, so that he may not become a public charge, or may be interested in private parks and hotels, *because these are institutions purely for private pleasure and gain*; but he may condemn and take the land for a public toll road, a public toll canal, or the like, or even for a private way.

So water cannot be appropriated and taken for any use which is purely private, and does not carry with it any public beneficial use; but it may be appropriated for any public beneficial use, although auxiliary to a private enterprise and private profit. Thus the use of water may be appropriated for manufacturing purposes—as to run a sawmill, a gristmill, a woolen mill and the like—for although these businesses are purely private and conducted for private gain, yet there is a public beneficial use attached to them, because the public at large need and must have lumber wherewith to build houses, flour out of which to make bread, and fabrics from which to manufacture clothes. And water may be appropriated by a farmer for domestic use and for watering stock, although for private convenience and gain, notwithstanding the fact that such use consumes the water, for the reason that there is a public beneficial use attached; but he may not file upon and appropriate water for the purpose of hoarding its use and withdrawing that use from the general public, the same as a miser hoards up and withdraws money from the public and from general circulation.

Where persons or a Company appropriate water in the arid region under the statute and construct a ditch for carrying the water appropriated, and supplying it to the lands through which the ditch passes, they take on the nature of—if they do not become—common carriers,³ and owe certain duties to the public, among which is the duty of supplying water to any adjacent land owner who may desire it, *whenever there is a surplus of water flowing in the canal, the beneficial use of which is not already disposed of to some one owning land along the ditch,*

who is using the water for a proper purpose, as for the purpose of irrigating his lands.

Having acquired the right to the beneficial use of water, the proprietors of a canal may dispose of it in any manner they see fit, and at any price they may fix, provided only it be reasonable and equitable. Thus the proprietors of a canal will not be permitted, even in the absence of statutory regulations, to fix an extortionate price, which practically means the prohibition of all use of the water, for no man can be permitted to do indirectly that which the law prohibits him from doing directly. In the absence of a statute governing, it is thought that the price charged for water must be an equitable one; in other words, such an one as will yield a profit on the investment, and enable the farmer to pay the rental, and yet secure a fair return for his labor. In Montana it is provided by statute that the county commissioners may fix the price to be charged for water. As a general rule, however, canal proprietors prefer to fix such a price for the use of the water flowing in their canal that there will be no occasion for the interference of the public officers.

A canal company which has been selling a right to the beneficial use of its waters at a stipulated annual rental may at any time change the method of disposing of such use, and charge a fixed price for permanent water rights in addition to a specified annual rental, *so long as they do not thereby impair or interfere with any vested rights of the owners of land under the canal.* They may not only do this, but they may also require that the water rights be taken within a certain time, and if they are not taken within that time by the owners of the lands under their canal, give notice that they will sell such water rights to any other person or persons, or that they will even refuse to sell them to any one.

It is thought that the only effect such proceedings would have upon any owner of lands under the canal would be to subject him to the liability of losing his right of priority to use, and if the appropriation of water was not sufficient to supply all the lands under the canal, he might be cut off entirely of any right to participate of the beneficial use of such water. Where water is flowing in a natural channel, the law is that "he who is prior in time is prior in right," regardless of his location on the banks of the stream. An irrigation canal is merely an artificial channel or stream flowing through the land, and the same rule applies—"first in time, first in right."⁴ But it is thought that so long as there is water flowing in the canal, the right to the beneficial use of which is not

sold and actually used, the land-owner failing to take out a water right for his land will be entitled to the use of as much of such surplus as his land may require, provided only there be so much, upon the payment of the fixed rental therefor.

It is a common practice with canal companies to sell what are known as "floating water rights." So far as the writer is aware, the legality of such sale of water rights has never been raised in any adjudicated case and the *status* of the holders of such water rights judicially determined. On principle, however, it would seem that such a speculation in water rights is a hazardous enterprise, where the purchaser is not an owner or holder of land under the canal which may be benefited thereby; for while water used in irrigating land is in many respects different from unappropriated water flowing in a natural channel through the land, and has been said not to be appertaining to the land,⁵ yet under an order from the county commissioners, who by law are designated to fix water rentals, the land owner who did not obtain a water right may still obtain water;⁷ and in the absence of statutory legislation on the subject, the company would be held, at common law, to have submitted itself to a reasonable judicial control, invoked and exercised for the common good, in the matter of regulations and charges; and an attempt to use its monopoly of water for the purpose of coercing compliance with unreasonable and extortionate demands would lay the foundation for judicial interference, and a *mandamus* would issue.⁸

From this it follows as a corollary that if a person who has been taking water from a canal company at a stipulated annual rental, neglects or refuses to take out a water right in compliance with a demand of the company as above suggested, so long as there is *a surplus of water unappropriated to actual use*, and which is running to waste for want of such actual use, he will be entitled to receive and use that water upon his land, upon application to the company and payment of reasonable charges therefor, notwithstanding the fact that floating water rights have been disposed of to persons other than actual owners of the land under the ditch, and the company has no more water rights for sale. It goes without saying that it would be otherwise where the water is all *actually used*, under such sale of water rights, on lands properly under the canal.

NOTES.

The notes of reference to legal decisions accompanying the article of Judge Kern's will be found on page 125.

THE ART OF IRRIGATION.

THE DANGERS AND EVILS OF THE FLOODING SYSTEM.

CHAPTER III. BY T. S. VAN DYKE.

MANY people soon discovered that depending on water to run in streams and soak the whole ground with anything approaching evenness was unsafe, and as it would not spread over the ground in a thin sheet but one thing remained, and that was to put it on in a thick sheet.

Even on level ground this could be done only by lines of dams or checks an inch or two in height, and on sloping ground they might run to a foot or more. It was quite natural to make them in lines crossing each other at right angles, and thus grew up the system of flooding in checks, which is one of the leading systems of the world to-day. It is very effective where well done, and on some soils is the only method available, as we shall see farther on, but it has been as badly abused as any other system.

During all this time no one ever thought of grading the ground to a uniform slope or anything near it. If there was a depression in one part, all the better. It took so much less of a dam or ridge of dirt on the outside to hold the water. That the water stood there a foot or two deeper than elsewhere, pressed down and packed the soil and deposited on it twice as much slimy sediment to form a crust that would exclude the air when the water was off, was quite immaterial, even if it had been thought of. If one part happened to be too high it was rarely, if ever, graded down. A larger check was perhaps made around it, and perhaps the center of it was left above water.

The sediment deposited from this style of work was deeper, finer and tougher than that deposited from water running in furrows. When the sun had smiled on it two or three days it began to break into big, thick flakes, the lifting power of which was remarkable, but the breaking was never sufficient to let the air into the ground; in fact, it was good only to pull out of the ground something you wished to keep there.

Though these primitive irrigators differed much in their ways of making the checks and running the water into them, their method of treating the ground when the baking process had reached its most ruinous stage was remarkably uniform. They simply poured on more water.

You may think I insult your intelligence when I tell you that you are very apt, if left to yourself, to imitate these miserable errors. Yet right here on the edge of the beautiful and prosperous city of Los Angeles, a city that has made its best growth during the late panic and where I can see out of the window

as I write, new roofs rising on every hand, in this city made by irrigation and surrounded by ditches under which is done the best work in the world, I can see within five minutes' walk of my home every one of the mistakes I have so far mentioned, and see them done over and over again. In some cases it is excusable, as where a man is irrigating a vacant lot or so for pasture for one cow. In this soil and under this sun almost any kind of work will give all the grass needed for one cow. So the Mexican style of garden is not so bad when one only wants a little fruit for home use. But these are not the reasons why poor work is done. It is because it is done by people who cannot or will not go to study the subject in places where it has been brought to perfection. You will incline to do the same if you have a chance. And the reason why I dwell so much on these errors is because the study of error is the surest road to truth.

Strange as it may seem, they one and all poured on more water when the ground began to 'bake' after an inch or two of the slime had settled upon it. This only made matters worse. More water was exactly what the ground did not need. Beneath the beautiful cake of sediment the soil was still moist enough, probably too moist. What it needed was air and not water. Yet water was all it got, the crust was thickened for the next drying, the air was excluded more than ever, the ground was kept cold from excess of water and packed hard under the additional weight and everything was injured except certain kinds of weeds, which were rarely disturbed. The basins thus formed were often left year after year. Sometimes they were made anew every season, but were rarely disturbed oftener.

Later irrigators began to use manure, and sand, tan-bark, saw-dust and other things as a mulch to retain the moisture and keep the ground from baking. But it was limited to a small space around the trees, and while it did prevent baking immediately under it the heavy, cold, tough, sodden and sour condition of the ground from too much water and too little air remained about as bad as ever. The effect of all such work was bad fruit and little of it compared with what is now seen on the same ground under the present methods. But as there was then nothing better with which to compare it the results seemed pretty good. In 1875 we used to think the oranges very good. We now know that they were sour, light, insipid, thick skinned, spongy and nasty. We can see the difference to-day, so that there is no imagination

about it. Grapes stood this drenching better than almost anything else, but nearly all deciduous fruits were ruined in flavor and keeping qualities; while garden vegetables were sadly cut down in yield and were dry, stringy and limp, instead of crisp and succulent. Nearly all attempts to raise grain in this way were dismal and expensive failures; corn grew yellow and mangy, with too many "nubbins;" beans, melons and many other things refused flatly to do anything of value. Many a man pronounced the soil, the country, the climate, the coast, the occident generally, a fraud, and sighed for the good old stony hills and howling winds of New England, where one could at least raise something fit to eat.

Meanwhile the soil was injured by this kind of treatment. Where it was open enough to permit it the excessive use of water leached out the nitrates which are such an essential element of fertility. Though in some cases this was partly compensated by the fertilizers in the water the general result was to impoverish and render "sour" many soils that were good at the start. In other cases the fine silt carried by the water formed a hard pan very rapidly at the bottom, especially where it contained much iron, or toughened the subsoil already there so as to affect materially the drainage, a very important item. Where the ground was very rich in iron a sheet of slushy clay heavily charged with iron settled on top of the hard pan or bed rock and injured the tender roots, killing some things and injuring others. Even where the drainage was naturally good it was often ruined by the filling up of the ground beneath with water to a point that was too near the roots. Where there was any hard pan this was easily and quickly done; and even where there was no hard pan, it was often done with quite as much certainty, the only difference being in the time required.

An instance of this occurred only three years ago, striking in its effects, so easily verified by any one who doubts it, and so valuable as a warning to one who thinks himself a natural irrigator and requires no lesson from any one, that I give it in full. A gentleman long resident in San Diego, California, a good lawyer and a man of wealth, with all the time and opportunities to travel and inform himself that any one could wish, owned an orange orchard in El Cajon some twelve miles back of San Diego. Land, climate and all other conditions were as good as the best to be found in this State. The trees were eighteen years old at that time. I was at this orchard in the spring with Charles Dudley Warner, who was then writing his book on California. The trees were just in bloom, the very time when great care should be taken with oranges about using too much water. The water stood around the trees in great vats ten or twelve feet square, and in many places at the lower sides fully a

foot and a half deep. So absurd was it that Mr. Warner noticed it at once, although irrigation was entirely new to him. Consequence number one: The trees had shed over one-half of their bloom, which lay like snow on the ground and water.

At the upper end of the orchard we found rows of these vats in all sorts of conditions. Some were a mess of slime that would mellow the soul of an old sow. Some were dried down to a point that would have made a good business basis for a brick yard. Some were beginning to crack into flakes just thick enough for prime adobes. But into all of them immediate preparations were in progress to turn in more water.

In the fall I saw the orchard again. Six or seven of the largest trees were dead. Dozens more looked yellow and measly. The crop was very light; the oranges were small and looked tired. After careful culling and selecting, the owner got two carloads of fruit that he thought fit for market. He should have had ten from an orchard of that size. He sent them to Chicago, where oranges were bringing a high price. Two months later he showed a few favored friends a draft. It was for \$65, to cover the loss of the consignee on the shipment. The same year orchards of the same age and same kind of trees, with conditions, soil and all else not a particle better, paid nine hundred and a thousand dollars an acre net profit.

For eighteen years this man had been spending money on this place and made it one of the handsomest in the country. It had been watered from a well *at the lower end*, from which the water was pumped by steam engine to a reservoir at the upper end, some sixty feet higher. The total water supply had been less than two miner's inches, enough to make a pretty place, but not enough for profit. So long as this well was the source of supply the place was well-drained. But in the year I speak of he began using water from the San Diego river flume, which ran along the hills above him. He made a contract which, he thought, called for seventeen inches of water. The Supreme Court, afterwards, thought otherwise, and cut it down to the two and a half inches that he intended the company to understand by his language when he drew the contract. But in the meantime he started in to get the worth of his money out of it, and used all he could get. This would have been too much, even had the place had the most perfect drainage. It was naturally a well drained place, with a slope of some sixty feet from the upper to the lower end. It was not underlaid with boulders or gravel, but had rotten granite below several feet of fine, rich soil. By fall the water in the well, that was over twenty feet below the surface when the well was dug, was almost at the surface,

and the roots of the trees that had always been far above the level of any underground water, now had it raised up to them so that many of them were in standing water. It would take about three seasons to get back into proper condition the trees that survived this treatment. This man, within the last ten years, had traveled over Europe and made another trip around the world, yet he could not go one-half a day's journey to see the best irrigation in the world, and learn how it was done.

The above is an extreme instance, yet there are hundreds more here almost as bad. Either from conceit, laziness or general stupidity, people will not go to see the object lessons that lie but a few miles from their noses. Nor will most of them believe for an instant that any other section can teach them anything worth knowing.

On ground not thoroughly drained by an open subsoil, or by sufficient slope with ditches on the top, this reckless use of water developed alkali at a rate that in a few years ruined thousands of acres of land once as fertile as any under the sun. Land with a tendency to alkali or underlaid by a stratum of water carrying alkali will be injured more or less by any irrigation unless it is well drained either above or below. And on all ground there is some danger of it, in any country, and under any system of irrigation, unless well drained. Good drainage is therefore as essential as a good water supply and must never be neglected. But this is the last thing dreamed of by the novice in irrigation. When alkali appears he knows but one remedy, and that is to pour on more water. Instead of bleaching out the alkali and running the water off, by which he could help the matter much and reclaim many kinds of soil from alkali, the early irrigator lets it soak in and carry the alkali down. When the ground dried it began to rise again in solution in the moisture rising to the surface by capillary attraction. There the solution was evaporated leaving the alkali as a white crust on the surface. This alarmed him. As long as it made no show he was not afraid. But as soon as it appeared on went more water to carry it down again and generate more at the same operation.

Alkali is nearly always a mixture of carbonate of soda and carbonate of potash with a little salt and carbonate of chloride of magnesia, and a trace of other salts. Little damage is done by any but the potash and soda. Both these are fertilizers but are in excess, and of the two the soda is much the more injurious. The amount of soda required by vegetation is much less than of potash and excess of it is far more injurious. The soda generally makes what is called "black alkali" and the potash what is called "white alkali." They are formed from the decomposition of the minerals forming the soil, principally from the decomposi-

tion of the feldspar that forms so important a part of granite. Where the rock lies in place in the hills, either as hard grey or blue granite, or as disintegrated by the oxidizing of the iron in the mica until it becomes rotten granite and washes away to the plains and valleys below, it rarely shows any trace of alkali, but in the large beds or sheets into which it is washed to form the valleys or plains it is apt to decompose whenever it is very fine and the drainage is interrupted by sheets of clay or hardpan forming below the surface. Hence alkali is not a sign of poor soil. It is only on good soil that it can form to any great extent unless brought there by water from some other place. It is not difficult to manage where the drainage can be made certain, and ground very full of it may be reclaimed by the proper use of gypsum or land plaster, the sulphuric acid in which unites with the soda, making sulphate of soda, which is quite harmless while the lime that formed the base of the gypsum is a fertilizer that is quite harmless in considerable quantity and is what most land needs as much as anything else.

The irrigator therefor instead of being alarmed at alkali must understand how to manage it, and the last way to do it is to pour on water and let it dissolve the white crust and soak into the ground with it. Its speedy reappearance at the surface is certain, and it will be strange if it does not bring company with it.

UTILIZING THE UNDERFLOW.

A company is being formed for the purpose of supplying Los Angeles with artesian water from a point a few miles south of San Bernardino. The promoter of the enterprise, Mr. A. F. Judson, of Colton, says:

"It is on a river bed, with an unlimited supply of water. I have traced this underground river from Baldy mountain in a southern direction to Elsinore lake. The southwest bank of the river being in place, cuts off the water supply from running southwest between this city and Colton. The iron, cement and black sand, characteristic of material for forming a mountain river bank, make the combination of this bank. Without the underground supply of water it would be utterly impossible for the mountain streams of Lytle creek, City creek and other small streams to supply one-half the streams that have already been developed.

"The city of San Bernardino virtually stands on an underground lake, which is supplied by this river. Facing the river across the mountain ranges into the San Jacinto valley there is an artesian belt from a quarter to half a mile wide that supplies artesian water, and many flowing wells have been developed.

THE NATIONAL ORGANIZATION.

NATIONAL EXECUTIVE COMMITTEE ELECTED BY THE IRRIGATION CONGRESS AT
LOS ANGELES, CALIFORNIA, OCTOBER 14, 1893.

CHAIRMAN, Wm. E. Smythe, Member-at-Large. Postoffice Box 1019, Chicago.		SECRETARY, Fred L. Allis, Member-at-Large. Los Angeles, California.	
VICE-CHAIRMAN, Edward M. Boggs, Arizona. Tucson, A. T.		TREASURER, John E. Jones, Nevada. Carson City, Nev.	
CALIFORNIA,	Eli H. Murray, San Diego.	NO. DAKOTA,	Dr. Merchant, Ellendale.
COLORADO,	J. F. Roche, Hardin.	OKLAHOMA,	John H. Cottrel, Guthrie,
IDAHO,	T. D. Babbitt, Nampa.	SO. DAKOTA,	J. T. McWilliams, Aberdeen.
ILLINOIS,	Willard E. Allen, Chicago.	TENNESSEE,	P. H. Porter, Nashville.
KANSAS,	J. W. Gregory, Garden City.	TEXAS,	J. J. Walker, Barstow.
MONTANA,	Z. T. Burton, Chouteau.	UTAH,	Arthur L. Thomas, Salt Lake City
NEBRASKA,	Chas. P. Ross, North Platte.	WASHINGTON,	N. G. Blalock, Walla Walla,
NEW MEXICO,	M. A. Downing, Las Cruces.	WYOMING,	Elwood Mead, Cheyenne.

COMMITTEE ON NATIONAL LEGISLATION,
W. A. Clark, Butte, Montana.
Eli H. Murray, San Diego, California.

Richard J. Hinton, New York City.
NATIONAL LECTURER,
J. S. Emery, Lawrence, Kansas.

PROGRESS OF THE WORK.

IN a circular letter, under date of February 1st, the chairman of the National Executive Committee submitted, for confirmation or rejection, the commissions named for the following States and Territories: California, South Dakota, Idaho, Nebraska, Colorado, Texas, North Dakota, Wyoming, Montana, New Mexico. There was no contest over these nominations, except in the case of Wyoming, where two sets of names were presented to the chairman, one by Elwood Mead, the member recognized by the committee, and the other by William Penn Rogers, of California, the person who, temporarily, represented Wyoming on the occasion of the Los Angeles Congress. The commission nominated by Mr. Mead, and submitted for the action of the committee, is as follows: Andrew Gilchrist, of Cheyenne; H. H. Reel, of La Barge; W. A. Richards, of Red Bank; C. H. Burritt, of Buffalo, and J. L. Torrey of Embar. In presenting these names the chairman outlined the Wyoming controversy as follows:

THE WYOMING INCIDENT.

William Penn Rogers, of Messina, Cal., represented Wyoming at the first meeting of the National Executive Committee, and made an announcement at the close of that meeting which was construed to be notice of his resignation. He stated that as he was not a resident of Wyoming, he should not act further with the committee, but should at once request the governor, who had appointed him, to name his successor. This was my understanding of Mr. Rogers' statement; and other members, so far as heard from, placed the same construction upon it. Furthermore, it was not contemplated that the very important power of naming a State Commission should be exercised by any one except a resident of the State duly chosen as a member of the National Committee.

Acting in accordance with this spirit, the committee, at its second meeting, held in San Diego, filled the memberships from Wyoming, North Dakota and some other States, which had been either temporarily represented for the purposes of organization by non-residents, or not represented at all. The members elected at the San Diego meeting have all proceeded to perform the duties of their office, and there has been no criticism of the committee's action, except in the case of Wyoming.

The person named as the successor of Mr. Rogers by the meeting of the National Committee at San Diego was Elwood Mead. Mr. Mead is a resident of, and taxpayer in the State of Wyoming. He fills the important office of State Irrigation Engineer, and has done so for years. He framed the model laws of the State relating to irrigation, and administers them as the head of the State system. He has already served for two years upon the National Committee with credit to his State and to the cause. He has named a commission, composed of representative citizens, against whose character and ability there is no shadow of criticism.

William Penn Rogers has notified the chairman and secretary of this committee that he intends to act as Wyoming's member, and to that end has nominated a commission. He claims that he was illegally removed. He has submitted printed statements of his case to several people, and I assume that you have been honored with copies.

For Mr. Rogers, personally, I have high respect. I consider him my personal friend, and do not doubt for a moment that he believes he is doing his duty, but it seems to me that it is a matter of the most vital moment, that the committee should, emphatically, confirm the commission named by Elwood Mead, who holds his title to membership by the unanimous vote of the members present at San Diego. By so doing we shall forever settle the important principle that only actual residents of States can be allowed to exercise important functions in connection with this committee. California has named one commission, as is her right. She does not claim the right to also name the commission for Wyoming through her citizen, Mr. Rogers, and such a claim would be untenable if asserted. An attempt has been made to bring the governor of Wyoming into this controversy. He has no proper place in it, as the rules laid down by the Irrigation Congress for the government of the National Committee distinctly provide that the committee shall fill all vacancies in its membership.

I have written at this length as a matter of justice to Mr. Rogers, but I do not wish it to be understood that I consider the Wyoming membership open to question. Nothing except the formal reconsideration of the vote whereby Elwood Mead was elected could affect the standing of Mr. Mead as a member.

The result of the vote of the committee is the confirmation of all the commissions. Mr. Rocho, member for Colorado, voted aye on all but Wyoming, and Mr. Gregory, member for Kansas, voted aye on all nominations, with the single exception of Mr. Andrew Gilchrist of Wyoming. As Mr. Mead is a resident of Cheyenne, and as the commissions of five usually include the State's representative on the National Committee, Mr. Gregory thought it proper to except Mr. Gilchrist, but that gentleman, in common with all commissioners from the States above named, stands confirmed. The members of these several commissions will at once enter upon their labors.

The commissions remaining to be nominated and confirmed are those of Kansas, Utah, Oklahoma and Washington.

THE ARIZONA VACANCY.

The resignation of Mr. Boggs from the Arizona membership has precipitated quite a lively contest between the friends of J. L. Van Derwerker of Yuma, R. C. Powers of Phoenix, and T. B. Comstock of Tucson. It is understood that the latter will not accept the place if elected. The vote of the committee is not yet all in, but up to date the vote is as follows: Van Derwerker, 7; Powers, 2; Comstock, 11. Judge Van Derwerker's friends are very energetic and enthusiastic, and the aggressive young man from Yuma seems likely to be chosen.

THE CESSION OF THE LANDS.

The recent meeting of the Trans-Mississippi Congress at San Francisco followed its own precedents of five previous years and pronounced in favor of the cession of the arid lands to the States. It would have been far more satisfactory to the friends of the national organization if the Congress had refrained from any expression on the subject, given a cordial recognition to the State Commissions, and remanded to the next Irrigation Congress the whole broad question of a national policy. A few members of the National Committee persist in believing that the Los Angeles Congress declared against the cession of the lands. It did nothing of the sort. It expressly referred the entire subject to the impartial consideration of the State Commissions, and announced that the next Irrigation Congress would undertake to formulate a policy upon the basis of these reports. The subject of cession was left in abeyance with all other projected measures. It is true that the platform stated that the irrigation problem was "national in its essence" and demanded national legislation, but the lands can only be ceded by national legisla-

tion. THE AGE will bring forward at the proper time a new policy, designed to erect every safeguard which the opponents of cession believe is essential for the protection of the people, and, at the same time, to secure all the benefits which friends of cession anticipate from State authority. In the meantime, it is unfair to represent that the Los Angeles platform pledged the movement either in favor or against any definite line of action.

IN THE SEMI-ARID REGION.

The enthusiasm of the semi-arid region continues unabated. Mr. I. A. Fort, president of the Nebraska Association, Mr. E. R. Moses, president of the Interstate Association, and Judge J. S. Emery, national lecturer, have been holding meetings at various points which have attracted a very large attendance. Arrangements have been perfected for a large interstate convention at Omaha, in the latter part of March. It is expected that several distinguished men will be present on that occasion.

IRRIGATION CONVENTION TO BE HELD IN OMAHA.

THE subject of irrigation is absorbing public attention, and the Interstate Irrigation Association, which was organized at a convention held in Salina, Kan., last September, is very aggressive in pushing the matter.

This convention was composed of delegates from Wyoming, Dakota, Nebraska, Kansas, Colorado, Oklahoma and Texas. State associations, under the auspices of the international association, have been formed in Kansas and Nebraska, and arrangements are being perfected for the organization of Colorado, Oklahoma and Texas.

Upon invitation of the Commercial Club of Omaha, the interstate association has decided to hold a convention in this city on March 21 and 22.

The objects of the convention to be held in Omaha are to memorialize Congress in behalf of national aid in determining the amount of water for irrigation on the plains. Mr. Bristow thinks it will be the largest irrigation convention ever held in the United States.

Articles of incorporation of the Settlers' Ditch Company have been filed with Secretary of State Curtis. The headquarters of the company is at Sweet, Boise county, Idaho, and its object is to build a ditch to cover the land on Squaw creek flat. The directors are: John Tally, president; William Carpenter, secretary; M. A. Dorman, time-keeper; John Brown, treasurer; George Williams. The capital stock is \$10,000, all of which is subscribed.

PULSE OF THE IRRIGATION INDUSTRY.

OUTLOOK IN EASTERN OREGON.

THERE is good promise of several important ditch enterprises being pushed ahead in eastern Oregon during the winter. This is especially the case around the town of Ontario, located in Snake River valley and on the Oregon Short Line railway. Last winter some heavy work was done on the upper section of a canal to take water from the Owyhee river and convey it on to the rich lands of the valley. A section of five miles has been nearly completed. This section takes the water out of the cañon on to the higher level land. The firm of Kiesel, Shilling & Danilson, doing general merchandise business in Ontario, have lately taken a contract to build the second section seven miles long, seventeen feet wide on the bottom and three feet deep, with the sides the usual slope of one to one.

Along that section reside about thirty families, who have filed on lands which they must get water on to for the purpose of proving up. The men have contracted to do the canal construction and take their pay in canal stock, thus making the canal and the company coöperative in ownership and operations. This will prove a great boon to these farmers who, because of the stringency of the times, could not secure their lands. The mercantile company furnish these farmers with goods and take their pay in canal stock. The third section of five miles has been let to J. T. Clement. This section will be thirteen feet wide at the bottom and three feet deep. This canal, seventeen miles long, will cover many thousand acres of land of excellent quality and in time it will be extended northward across Malheur river by means of a high flume, and then onward to cover the bench lands on the Oregon side of Snake river, a distance of twenty or thirty miles. Four years ago Kiesel, Shilling & Danilson planted fifty-three acres of their 320-acre fruit ranch in fruit trees, and the coming season will see much fruit on the trees. They have their land laid off in forty-acre lots, part of which are seeded to alfalfa, timothy and other grasses, and it is surprising what good crops these lands produce, and only a few months ago it was the home of sagebrush, lizards and toads.

Mr. Wilson, who owns part of Ontario town site and valuable lands near, is getting ready to construct a canal fourteen miles long to parallel the Owyhee canal, but on lower ground. Both these canals are to have water running through their entire length early next April. Just over the Snake river in Idaho the Payette and other ditches are in good shape, thou-

sands of fruit trees are being planted this fall, and more will be in the spring. Surveyors are busy running lines looking to the extension of the high ditch from Fayette river to Weiser and the country around.

NORTH PLATTE, NEBRASKA.

This canal takes its water from the North Platte, north of Southerland, Lincoln county, Nebraska, and wastes into the North Platte, north of that city. The canal is about 25 miles in length and 32 feet wide at the head. The soil between the North and South Plattes in this portion of Lincoln county is as well adapted to raising potatoes as the land in the vicinity of Greeley, and there were in the neighborhood of 200 cars of potatoes raised under the North Platte canal last season. The farmers are just commencing to grow alfalfa, which does as well in Nebraska as in Colorado. The company owning the North Platte canal also own several thousand acres of land along its line, which they are cultivating, building houses and placing a tenant on each 80 acres. Just northwest of North Platte Mr. W. F. Cody and Mr. Isaac Dillon own several thousand acres of land. They have just commenced to build a new ditch about 7 miles in length to irrigate the greater portion of this. About 12 miles northwest of North Platte Messrs. Paxton and Hershey own about 4,000 acres of land, which they expect to improve in the near future, cut it up into 40 and 80-acre tracts, and place tenants on the land to raise crops. The Irrigating Convention that was held at North Platte last month appears to have awakened considerable interest in the subject, and if the contemplated improvements are made in the vicinity of that town, the face of the country will be changed in the next two years.

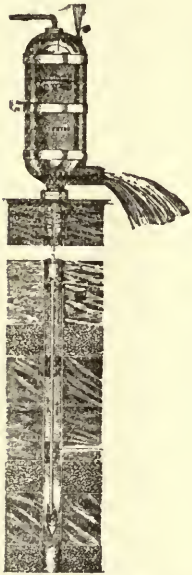
IRRIGATION FROM WELLS BY WIND POWER.

[EXTRACTS FROM AN ADDRESS BY I. L. DIESEM OF KANSAS.]

My well is 13 feet deep and 18 feet in diameter, and I generally have 5 or 6 feet of water in it. If I were to put in another plant I would put down points instead of digging a well, and save expense. The pump I use has an 8-inch cylinder, with a 12-inch stroke, and is run by a 14-foot windmill, and in an ordinary wind makes from 38 to 42 strokes per minute, pumping 2½ gallons per stroke, or 100 gallons per minute. To make a success it is necessary to have a reservoir to save the water until there is sufficient to irrigate with. In irrigating any kind of a crop it should be done as quickly as possible, so as to make the least water go

the farthest. I have two reservoirs, one 60 by 150 feet, and the other 30 by 150 feet, and have irrigated with this plant from ten to fifteen acres each season. The greatest difficulty to overcome is to learn economy of water. Reservoirs can be built at very small expense. If you wish to make one 50 by 100 feet you take from the inside of the dimensions from 8 to 12 inches of earth, and it will make your banks from 4 to 5 feet high, which is high enough for all practical purposes. The western plains are blessed with cheap wind power, and here in Kansas the wind will run a common windmill one-half the time at a cost not to exceed one dollar a month for running, except for accidents. Almost every man who has 20, 40 or 80 acres of land can in this way own and control his own irrigation system. "A little farm well tilled means a large garner well filled."

THE CHAPMAN ARTESIAN WATER LIFTER.



This is an invention which causes non-flowing wells to flow without pumping, and it is claimed will deliver from two to five times more water than can be pumped, and is more economical than any other means of raising water in large quantities. Air is forced down a small pipe and comes up in a cone shape, filling the well pipe, carrying the water up with its force. It is suitable to be used in wells of any depth, and any number of wells can be operated from one engine at the same time. It is especially valuable where water is not within reach of a suction pump, where the deep well pump does not lift enough water, where there are gases in the artesian

water, as the injected air removes the gases, where a number of deep wells have to be operated by the same power, where the water is sandy and cuts ordinary pumps. This novelty in the water lifting line is made by the American Well Works at Aurora, Ill.

WORK ON THE CROW RESERVE.

WALLER H. GRAVES, the prominent irrigation engineer, was a visitor in Chicago a few days ago. He has recently come from the Crow reserve in southeastern Montana, where he is engaged under government direction in building an extensive system of irrigation canals. For the greater part of three years

he has been pushing the work and has accomplished a great deal during that time. Although the Crow nation numbers but 2,500 people, yet the scheme as outlined by the government contemplates putting 150,000 acres of land under ditch, and for this work \$400,000 have thus far been appropriated. The water is taken direct from a number of streams in Yellowstone county, and Mr. Graves says there is a superabundance of it for irrigation purposes. All the construction work is done by the Indians, under Mr. Graves' direction, and he speaks in the highest terms of their ability in this line. The largest canal thus far built is 14 feet in the bottom. Last year the Indians raised splendid crops by the aid of irrigation, and big profits were derived from the sale of their hay. The project has been carried out in a very successful manner up to date. Mr. Graves is now in Washington in consultation with the officials of the Indian bureau.

IN WASHINGTON.

THE AGE is indebted to Dr. N. G. Blalock for the following list of ditches built near Walla Walla, last year.

The Willis ditch, 14 miles long, water taken from south side Walla Walla river, 5 miles south of Walla Walla city; ditch 8 feet in bottom, will cover about 25,000 acres. Frank Lowden's ditch, 15 miles long, water taken from north side Walla Walla river, six miles west Walla Walla city, size same as the Willis ditch; Lowden's ditch will cover 20,000 acres. Frank Lowden's Dry creek ditch, 3 miles long, water taken from Dry creek, 12 miles west from Walla Walla city; size of ditch 5 feet in bottom. Lowden's Mud creek ditch, $3\frac{1}{2}$ miles long, same size as above two ditches; covers 20,000 acres. The Hawley ditch, water taken from the Tonchet river 16 miles west from Walla Walla city, size 8 feet in bottom, length 15 miles; covers 10,000 acres. The Wallula ditch, sometimes called Wolf ditch, water taken from south side Walla Walla, 20 miles west Walla Walla city; will cover 10,000 acres; size, 8 feet in bottom.

THE AMERICAN SOCIETY OF IRRIGATION ENGINEERS.

The first Year Book will shortly be issued. It has been somewhat delayed but will lose none of its value. Under the administration of President L. G. Carpenter, Professor of Irrigation Engineering, State Agricultural College, Fort Collins, Colorado, and Secretary Jacobson, C. E., Assistant State Engineer of Colorado the membership has steadily increased. The society now has 144 members.

PERSONALS.

C. E. STEVENSON, the well-known irrigation engineer of Boise, Idaho, is going to Fresno, Wash., to make that place his home.

* MR. JAS. T. TAYLOR has resigned his position as engineer of the Riverside (Cal.) Construction Company to accept the position of engineer to the Colton Water Company.

W. D. ARNOTT, who made an excellent reputation as an irrigation engineer in the West during the last twenty years, has finished his work with the Boise Nampa Company and is now busy with a new system of ditches near Walters Ferry, Idaho.

A CORRECTION.—In the editorial study of the Turlock-Modesto works it is stated that the original plans were made by Col. Mendenhall and that Wm. McKay had been the constructing engineer from the beginning. A letter received from Eugene H. Barton, of San Francisco, explains that he was the original designer of the dam and had charge of the construction until the dam reached the height of 68 feet, his plans and specifications being, however, followed until the completion of the work.

VALUE OF WATER POWERS.

The theory of the modern engineer, as was outlined by Ferris in an interview some months ago, is that as the fuel of the earth becomes more and more exhausted, men will turn more and more to the water power of the earth to obtain power for the world's use, and as the cost of transmission, or at least the loss through transmission, has within the last eighteen months been reduced more than 50 per cent., the belief is that in a little while the matter of distance will not very much count, and so wherever there is a waterfall there will likewise be the apparatus to put that fall to work and make it supply men with the power they need to carry on their works. Considering that it is only ten years since the first electric motor was put to work, it is not impossible to suppose that in twenty years one stream after another will be levied upon to supply the power to carry on the inter-continental commerce of this country, to haul the cars, to turn the wheels and the looms, and make a new agent man's chief servant in the hauling of commerce.

CEDING THE LANDS.

Senator Carey, of Wyoming, has introduced a bill providing for the donation of 1,000,000 acres of arid lands by the government to each State in which such lands are situated, the State to reclaim the lands and put them into the hands of actual settlers, as under the homestead laws. He believes that limited cession is

better than giving the State the whole acreage, as it will prevent waste. The lands, according to Mr. Carey's bill, are to be reclaimed within six years, and not more than 300,000 acres are to be set over to the States in any one year. All lands, exclusive of timber and mineral lands, which will not, without irrigation, produce some agricultural crop, shall be deemed arid lands under the provision of the bill.

The states affected by this bill are Colorado, Nevada, Idaho, Montana, California, Oregon, Washington, North Dakota, South Dakota, and the Territories of Arizona, Utah and New Mexico.

IN CALIFORNIA.

After several years of litigation, the San Joaquin Land and Water Company of Stockton, this State, recently elected a new board of directors, and will proceed with the great work of bringing water from the Stanislaus river.

The new board of directors is composed of Colonel G. B. Sperry, W. C. White, Charles Belding, R. E. Wilhort, J. R. W. Hitchcock of the new forces, and N. S. Harrold, H. O. Southworth, H. W. Cowell and A. M. D. McIntosh of the old crowd.

The company owns valuable water rights near Knight's Ferry, and has expended \$207,000 in the works, having a dam, several tunnels and a long line of canal nearly completed. The estimated cost of completing the work will be \$400,000, and the canals will carry water to 150,000 acres.

AN IRRIGATION DISTRICT FOR COLORADO.

Something similar to the Wright irrigating law of California is asked for by William Mathews, irrigation superintendent for the district taking water from the Arkansas river. He wants the formation of a district incorporation legalized by the legislature, by which bonds can be issued and the Twin lakes and other reservoirs built and equipped so that the water that goes to waste in June, July and the winter months may be saved. According to Major Powell's measurements, the average flow of the Arkansas river is 2,778 cubic feet a second in May, 4,523 in June, 2,528 in July, 1,599 in August and 1,250 in September. The capacity of the ditches already in operation is about 1,700 cubic feet, while those proposed, if in operation, would run the total to 10,995 feet for which Mr. Mathews figures out a supply that can be depended on of 1,560 cubic feet.

IT IS WORTH WHILE

Writing to the U. S. Experiment Station, Washington, D. C., for list of seeds distributed to farmers in the arid region.

IN NEW MEXICO.

The Mesilla Valley Irrigation Colony Company has filed articles of incorporation.

The incorporators are: N. E. Boyd, of England; W. T. Thornton, of Santa Fé; A. M. Loomis, E. V. Berrien, E. C. Roberts, P. E. Kern, J. L. Campbell, of El Paso; W. S. Hopewell, of Hillsboro; P. Freudenthal, and Henry Bowman, of Las Cruces.

The company is organized with a capital stock of \$25,000. The water is to be taken from the Rio Grande. The principal places of business are at Las Cruces, El Paso, Albuquerque, Chicago and New York.

FARMERS' MAPS.

In France the government is preparing maps to illustrate the chemical qualities of the land in the various parts of the country, so as to show the best fertilizers for each particular section. Why would it not be a good plan for the Western States to publish fruit maps showing the location and range of the lands best adapted for special fruits? There was material enough exhibited from different portions of the arid region at the World's Fair to make a good beginning.

THE EDDY POWER DAM, EDDY, N. M.

The Haggerman power dam is nearly completed. It is furnished with four turbine wheels of 65 horse power each, and each capable of operating two Wellington duplex pumps; the plant will operate also an electric light plant, ice manufactory, water works pumps, and manufacturing establishments; the reservoir formed by the dam holds 29 million cubic feet of water.

OF COURSE.

Anticipating quite a demand for the article copied from THE IRRIGATION AGE last week, on "Irrigation by Windmills," a large number of extra copies of *The Oasis* were printed, but before Friday night they were entirely gone, with a demand for more. For which reason the paper is reprinted this week, and will be found again on the first page.—*The Oasis, Ariz.*

IN EGYPT.

Four proposed sites for a storage reservoir for irrigation when the Nile is low have been inspected. Three of the schemes are for building a dam across the river, and the fourth proposes to use the natural depression of the Wady Raian by filling it with the flood water of the Nile.

IRRIGATION ATTRACTS THE BEST.

Arizona papers are full of enthusiasm over the visit of D. B. Robinson, vice-president of the A. T. & S. Fé R. R., accompanied by the Hon. Robert E. Lincoln, N. K. Fairbanks, Marshall Field and Norman Ream, who are studying the results of irrigation in the West.

THE RIGHT WAY.

The Las Vegas, N. M., papers are full of discussion over the irrigation of that old Spanish grant. The object is to unite the three cities and one of its present ditches into one complete system. That is the right way, brother *Optic*, cogitate, agitate, irrigate.

Both the East Riverside and Gila Bend canals run across the 23,000 acre reservation of the Papago Indians, in Arizona, but do no good until the western edge of the reserve is reached. As the tribe does not number over 30, the settlers have petitioned Congress to move the redskins onto another reservation.

Messrs. Itagaki and Miyazaki, of Japan, have produced from the nettle hemp threads of the fineness of No. 100, a fineness never previously obtained even by the silk manufacturers of France. The nettle hemp is said to be three times as strong as silk, finer, and equal in luster.

The Bothwell irrigation canal in Bear Lake county, Idaho, which cost over \$2,000,000, has been put into the hands of a receiver on account of unprofitable business. The water rates charged were so high that the farmers refused to pay them, getting along without water.

It is reported that the state of Chihuahua, Mexico has granted Mr. Frank S. Kirkland concession to obtain water for irrigation purposes from the river Conchos, at a point 1,200 to 1,500 meters distant from the town of Santo Domingo.

Walla Walla, Wash., is to have an irrigation canal in the southwestern portion of the valley, just above Dry Creek cañon, covering 3,500 acres of fine land. Work is expected to be begun in the spring.

Senator White, of California, has introduced a bill appropriating \$250,000 to be expended by the Secretary of Agriculture to determine upon the best plan for reclaiming the arid West.

A large sized boom in apple planting, in Oregon and Idaho, is the result of their fine exhibits at the World's Fair.

An enterprise known as the Lima Reservoir and Irrigation Company has been incorporated in Centennial Valley, Beaverhead county, Montana, with a capital stock of \$100,000. Object to build a dam across the Red Rock creek, and a canal so as to put water on some 80,000 acres of land lying below the dam, and in the vicinity of the town of Lima. It is expected that soon the canal will carry water to the vicinity of Dillon.

It is rumored that there is a project on foot for a German syndicate to put out 300 acres of hops near Payette, Idaho. We shall await developments with a good deal of interest, because such a move would at once bring this section of the country into prominence it has not heretofore enjoyed, resulting in great benefit to all.

William H. Rowe, of Salt Lake City, was appointed receiver of the properties of the Bear Lake and River Water Works and Irrigation Company, at the suit of the Jarvis-Conklin Mortgage Trust Company. He qualified with bonds filed of \$15,000 and will at once enter upon his work.

The largest irrigating flume in California has just been completed. It is in Fresno county and is 52 miles long. It will bring 40,000 acres under cultivation. Many million feet of lumber will also be floated down annually.

In Paradise valley, Arizona, a Pennsylvania syndicate has projected and surveyed an immense storage reservoir on Cave creek. It will cost \$250,000 and will irrigate about 30,000 acres of rich land not far from Phoenix.

The irrigation construction or repairs expenditures for 1893, in Scott's Bluff county, Nebraska, is reported at \$42,013 for twelve different ditches, seven being new work, three enlargements and two repairs.

The Chicago & Rock Island railroad have a fine permanent exhibit, in Chicago, of the products of irrigation from the Pecos valley, N. M. A good example for others to follow.

California puts the rest of the country under obligations by supplying us with 33,000,000 pounds of raisins every year, most of which are eaten in the United States.

San Luis valley, Colorado, farmers discovered this year that it was more profitable to feed sugar beets to hogs than to ship them to Utah sugar factories.

The largest hop ranch in the world, 600 acres in one body, is in King county, Colorado.

It is proposed to build an electric railroad from the town of Shoshone to Shoshone Falls, Idaho. The distance is 40 miles. The power will be obtained from the falls.

Yakima and Sunnyside are enjoying almost a boom in spite of the hard times. Their irrigation canals have made a wonderful change in that part of Washington.

Irrigation is the mania all over central and western Nebraska, just now.

America sent nine millions of dollars abroad last year for olive oil.

NEW COMPANIES.

N. Yakima, Wash. The Prosser Falls and Priest Rapids Canal Company have secured the money to build their irrigation works.....*Greeley, Col.* The Benton Drainage Ditch Company propose to build a canal from Lake Windsor to Greeley, utilizing the seepage water and draining the thousands of swamp lands along the route.....*Emmet, Idaho.* The farmers recently held a mass meeting to organize a company for irrigating the bench lands around Emmet.....*Nampa, Idaho.* The Nampa Land and Improvement Co. have elected Fremont Woods, president, and P.W. Duffee, secretary.....*Spokane, Ore.* The Columbia Irrigation Co. propose to reclaim the desert lands adjoining the Yakima Indian reservation. The canal will cross the reservation and benefit about 1,200 Indians, besides opening a large body of fine lands to settlers.....*Sargent, Neb.* The Middle Loup Valley Irrigation Company, composed of farmers and local business men, will build a canal thirty miles long to irrigate 50,000 acres of land. E. P. Sargent is president. This canal is not to reclaim desert lands, as the lands of Custer county have never failed to produce good crops; but the prosperous people of that region propose to increase their means or facilities for greater prosperity.....*Fort Morgan, Col.* The Fort Morgan canal will soon be transferred from the directorship of the Travelers' Insurance Co. to a new company composed of the farmers owning lands under the ditch. The farmers propose at once to repair and extend the system.....*San Bernardino, Cal.* A company has been incorporated here with a capital stock of \$2,500,000 to erect a dam at Victor Narrows on the Mojave river, 150 feet high, which will make a lake nine miles long by three wide, a big thing for the Mojave desert if carried out.....*Brigham City, Utah.* The citizens are much elated with the prospects of a branch of the Bear river canal being brought out on their side of the river.....*Ellensburg, Wash.* It is reported that the Kittitas Valley Irrigation Canal Co. have secured the capital necessary to carry out their work.....*Prescott, Ariz.* Messrs Snow and Storms propose to build a storage dam on the Big Chino wash and irrigate 2,000 acres of land with flood waters. If there is anything in a name they ought to succeed.....*Kearney, Neb.* It is proposed to dig a canal from North Platte to Kearney.....*Deming, N.M.* E. J. Reed and others have organized a company to irrigate the valley of the Rio Grande for a long distance above and below Albuquerque, placing the canals high up on the mesa.....*Fort Morgan, Colo.* Ex-Senator Dorsey says that the Bijon ditch is to be finished, and that the contract for bonds has been signed.....*Aspen, Colo.* The Castle Creek Water Company have filed their articles of incorporation. J. F. Deveraux and others are pushing this work.....*Boise, Idaho.* D. C. Grosbeck, of Star, and others, propose to irrigate the lands on the bench on the north side of the river between Boise and Middleton. It is a farmers' co-operative enterprise.....*Montana.* The ranchmen

along the Yellowstone are building a canal from Grey Cliff on the Yellowstone to irrigate some 15,000 acres.....*Payette, Idaho*. Hon. R. A. Cowden says that the Payette canyon canal is now assured. It will be 15 miles long and cover 25,000 acres of choice bench land.....*Farmington, N.M.* The Riverside canal is being extended and widened, and a large force has been set to work on the Coolidge ditch.....*Santa Maria, Cal.* Messrs Goodwin and Adams report good progress in organizing the settlers into an irrigation company.....*Albuquerque, N.M.* The Santa Fe Water and Investment Company are said to have purchased the city water works and will also start an irrigation system covering the city.....*Beaver, Utah*. John Farr and others have located a dam site at the narrows of the Virgin river.....*Ritzville, Wash.* Plans are completed for reclaiming 50,000 acres near this town.....*Tucson, Ariz.* C. W. Wright and others have organized the Canoa Land and Water Co. for irrigating in the Santa Cruz valley.....*Wild Flower, Cal.*, will build irrigation works for 40,000 acres.....*Lugonia, Cal.* The Park Water Co. has been organized; capital, \$50,000.....*Saguache, Colo.*, is to have a storage reservoir at the expense of the state.....*American Falls, Idaho*. Organized, the Clear Lake Mining and Irrigation Co.....*North Loup, Neb.* Organized, the North Loup Irrigation Co.....*Lodge Pole, Neb.* The new Lodge Pole Irrigation Co. is a farmers' co-operative organization.....*Burwell, Neb.* Incorporated, the Burwell-Ord Irrigation and Power Co., to cover 20,000 acres along the North Loup river.....*Roswell, N.M.* The Penasco Irrigation Co. has located a reservoir site.....*Asotin, Wash.* It is proposed to irrigate 80,000 acres near this town.

CANAL BUILDING.

Sunnyside, Wash. The Sunnyside Canal, 40 miles long, is finished. It cost \$559,000 and will irrigate 64,000 acres of land; D. R. McGinnis, Sec'y.....*La Plata, Colo.* The Jackson Ditch Co., who lost their dam last summer, have made repairs and are ready to deliver water again.....*Tuma, Ariz.* Work on the Gila Bend canal dam is being pushed as rapidly as possible, and a dam is going in that will defy the floods.....*Bayard, Neb.* The reorganized Nine Mile Company have nearly completed their ditch. The Alliance canal, on the south side of town, is being pushed to completion; A. P. Kittell, engineer.....*Galloway, Montrose Co., Colo.* Hon. P. Galloway has nearly finished the dam across the Dolores.....*Phoenix, Ariz.* Work has begun on the new mammoth dredger of the Consolidated Canal Company above Mesa. It will be the largest dredger used in the construction of irrigating canals in the world. The crane will be 80 feet in length, and the construction of the boat will consume over one hundred thousand feet of lumber. Over 100 men are hard at work upon the Big Gila dam of the Peoria Canal Company.....*Modesto, Cal.* The board of directors of the Modesto and Turlock irrigation districts have accepted the dam from the contractors, and are surveying the districts for an extension of the canal system.....*Yakima, Wash.* The Belle Haven irrigation district is now operated under the Wright law system. *Santa Cruz, Ariz.* Land under the new Allison ditch will be cultivated this year.....*Poso District, Kern Co., Cal.*, will use its new canal this season.....*Grapeland Irrigation District, Cal.*, have run an 800 foot tunnel under Lytle creek below Bed Rock.....*Los Angeles, Cal.* Dr. Mulholland reports the Indian Wells Valley system as well under way.....*Fresno, Cal.* The great Sunset canal, covering 300,000 acres and calling for 282 miles of ditch, has been commenced.....*Bessemer, Colo.* The reservoir and ditches are being completed.....*Eddy, N.M.* The Seven Rivers reservoir is filling up behind the new dam.....*Ferron, Utah*. A large canal is being taken out of the Ferron river.

VALUABLE PAPERS.

"Water Pipe Trenches," *Jour. N. E. Waterways, New London, Dec.*..... "Determining Minimum Section for Overfall Masonry Dams," *Eng. News, N. Y., Dec.*..... "Electricity in Suburban Development," *Eng. Mag. N. Y., Feb.*..... "Electrical Power from Niagara," *Electr. Eng., N. Y., Jan.*..... "Notes on Water Power Equipment," *Eng. Record, N. Y., Dec.*..... "Comparative Tests of Hydraulic Dams" and "Flow of Water Through an Orifice," *Sibley Jour. of Eng., Ithaca, N. Y., Jan.*..... "Pipe Calculations in relation to Water Powers," *Am. Machinist, N. Y., Dec.*..... "About Siphons," *Am. Machinist, N. Y., Jan.*..... "Artesian Waters of the San Joaquin Valley, Cal.," *Eng. Record, N. Y., Jan.*..... "The Pumping Engine, its Faults, Points and Peculiarities," *Fire and Water, N. Y., Jan.*..... "Natural Filtration of Water," *Eng. News, N. Y., Jan.*..... "Revival of Farming," *Contemporary Review.*..... "The Agricultural Problem," *Economic Journal.*..... "Electricity in Agriculture," *Deutsche Revue.*..... "Irritability in Plants," *Revue Scientifique.*..... "Water Powers," *Cassiers Mag.*..... "Irrigation and Prosperity," *Headlight, Deming, N. M.*..... "An Agricultural State," a lecture by Prof. Mead, *Tribune, Cheyenne, Wyo.*..... "What Irrigation Means for Kansas," *Farmer, Topeka, Kan.*..... "Pumping by Wind Power," *The Irrigator, Winter Park, Florida.*..... Reports of the State Agricultural Societies, *Lincoln, Neb., Topeka Kan., Minneapolis, Minn. and Indianapolis, Ind.*..... "Irrigation and Politics," *Farm and Ranch, Dallas, Texas.*..... These papers can be obtained by sending through your local news dealer.

LEGAL NOTES

ACCOMPANYING JUDGE KERR'S ARTICLE ON PAGE 113

(1) It is said by the Supreme Court of California in the case of *Kidd v. Laird*, 15 Cal. 161; s. c. 76 Am. Dec. 472, that water cannot be held by *private ownership*; but that a *right to its use* may be acquired, which will be regarded and protected as property, but this right is not a special property in the water itself.

(2) Persons filing upon and appropriating water are proprietors to the extent of the beneficial use, and their title can be defeated only by failure of application of the water to a beneficial use. *Wyatt v. Larime & Weld Irrigation Co.*, (Colo. App.) 29 Pac. Rep. 906. Merely constructing an irrigation canal does not give a prior right, unless the water diverted be applied to a *beneficial use*; a mere diversion is not an appropriation to a beneficial use. *Coombs v. Agricultural Ditch Company*, (Colo.) 28 Pac. Rep. 966. The same is true of an *excessive appropriation*. *Id.*

(3) It has been said, however, that the liability of an irrigation ditch company for failure to supply a certain volume of water to the persons holding water rights, according to contract, cannot be determined on the theory that the company is a common carrier. *Wyatt v. Larime & Weld Irrigation Co.*, (Colo. App.) 29 Pac. Rep. 906.

(4) *Hillman v. Hardwick*, (Idaho) 28 Pac. Rep. 438.

(5) *Stickler v. City of Colorado Springs* (16 Colo.) 61; s. c. 26 Pac. Rep. 313, followed in *Bloom v. West*, 32 Pac. Rep. 846.

(7) See *South Boulder & R. C. Ditch Co. v. Marfell*, 15 Colo. 302; s. c. 25 Pac. Rep. 504.

(8) *Wheeler v. Northern Colorado Irrigation Company*, 10 Colo. 582; s. c. 17 Pac. Rep. 487. See *Price v. Land Co.*, 56 Pac. 431; *Railroad Co. v. People*, 56 Ill. 365; *Vincent v. Railroad Co.*, 49 Ill. 33; *Mun v. The People*, 94 U. S. 113; bk. 24 L. Ed. 77.

COLONY BUILDING.

COLONIAL SETTLEMENTS IN THE ARID WEST.

BY W. C. FITZSIMMONS.

PERHAPS the greatest ultimate advantage to follow the irrigation of cultivable land in the arid belt is the facility thus afforded for colonial settlements. Isolation has ever been, and now is, everywhere the bane of agricultural life in the United States. Less progressive people in some other countries have, from time immemorial, set us a better example. The farm village is common in many countries, and is not unknown even in Mexico and the Central and South American States. Unhappily, it is rather the workers upon surrounding lands and not the land owners who form the villages. The custom of living in villages and going forth to the labor of the field at sunrise may have had its origin in the necessity for banding together as a protection against wild beasts or savage men. In any event, the custom prevails largely in other countries than our own, and has manifold advantages which need not be here specified.

The ideal and possible American farm village, however, is not one wherein are grouped in wretched hovels the ill-fed tenants of a "land baron" who maintains himself in princely state elsewhere; but one made up of elegant homes and little farms, each one tended by the happy, educated and independent owner and his family. Such centers of education, refinement and good citizenship are nowhere so easy of realization as in the irrigable arid region. Indeed, they are practically impossible in non-irrigable sections, and any near approach to these desirable conditions in most of the older States can never be obtained. It is only where the control of a sufficient water supply makes possible the maximum products of land that subdivision into small holdings can be carried to the point of a self-supporting farm village or small colonial settlement. In the vast irrigable sections now lying bleak and dreary on the endless plains of Texas, or among the snow-clad peaks of Montana, are thousands of the most eligible sites for colonies which a proper development of irrigation systems, either general or local, would make immediately available. To the casual observer these dismal wastes are a terror, and the Ohio man, or the man from Illinois, who sees them for the first time, experiences a sensation akin to that of the traveler who leaves the green border edging the Nile and betakes himself toward the limitless dreariness of Sahara. To him these regions appear to be forever

destined to be wholly given over to desolation, and entirely beyond the power of man to make fit for human habitation. No greater error could be made. These most uninviting stretches of monotonous, plain and struggling herbage are the broad stages upon which are certain to be wrought, in the not distant future, some of the most remarkable transformation scenes ever witnessed by man in any country. These gloomy realms, now the inhospitable home of the coyote and the prairie dog, are destined to become the centers of the highest type of rural life upon the continent. Let this soil, now as bleak as interstellar space, but feel the revivifying touch of water from the mountain stream and the miracle is wrought!

The hardy pioneers who toiled over interminable stretches of muddy and dusty roads to reach the heavy timber lands of Ohio and Michigan in the early "thirties," believed they were leaving the stony hill-sides of Connecticut, or the worn out lands of southern New York, for a land flowing with milk and honey, and such they found it, not *in esse*, but *in posse*. The labor of clearing the dense forests of oak and hickory, of sycamore, birch and maple, would today appall the stoutest heart, to say nothing of paralyzing the strongest arm. They wrought as no slave of the cotton fields of Georgia would have found himself equal to, and spent their strength and their years in destroying the magnificent growth of timber to make way for the log cabin and the stumpy, ill-cultivated field. The conditions of farm life in these years and in these wooded fastnesses were laborious and inconceivably irksome. Yet these pioneers builded mighty States, and a high degree of civilization followed the sturdy strokes of their brawny arms.

But what required their patient toil and Spartan fortitude half a lifetime to achieve may now be wrought out on the desolate plains of the arid West within the space of a few months, and with but a tithe of the mental and physical strain which fell to the unhappy lot of those elder builders of the commonwealth. Let the wealth of waters falling upon the mountain areas but be impounded and poured in unceasing bounty upon this bare soil and the work is done. There is no laborious felling of the gnarled oak, no interminable waiting for the scanty crop. The husbandman may at once mount his machine plow, and while sitting at his leisure admiring the scenery and contemplating his happy condition, prepare more land in better condition for a crop in a single day than his father could have done by the grinding toil of a week among rocks or stumps. This is no fanciful sketch. All this has been done a hun-

dred times in many places, and the man who travels in the right direction will find object lessons by the thousands to fully convince him of the truthfulness of the statement here made.

This is an age of coöperation. Nearly every great business, social or political enterprise, is the result of coöperative efforts toward a definite end. The present conditions of life are such that individual effort along nearly all lines is comparatively unavailing, especially if met by unorganized opposition. It has thus come about that the isolated individual farmer is at the greatest disadvantage in the struggle for supremacy. As a matter of fact it has become with him largely a mere struggle for existence. That this condition has not come about through lack of honest effort or intelligence is obvious to thinking men; but has come to be the result of preëxisting conditions largely necessitated by the area of land required for the decent support of a family.

The best possible conditions flowing out of the culture of the soil result from the careful, scientific cultivation of a small acreage. The smaller this acreage is consistent with the purposes of its tillage, the better for the individual, the family and the State. Of course, the division of land under unwise law or custom may be carried too far, as in France under the law of 1793, requiring land owners to divide their estates at death equally among their heirs. But the tendency in the United States has been rather in the opposite direction, and enormous land holdings in many parts of the country are to-day a bitter foe to progress and to the prosperity of the masses.

Right here in the arid region is the place to check this great evil, and by a system of just and equitable laws forever prevent the fish-like swallowing of the small landholder by the great one. Careful investigation has led the writer to the conclusion that throughout a large part of the arid region, forty acres should be the limit of the average farmstead. In many parts where climatic conditions are specially favorable, it might be safely reduced to twenty acres. All over California are found localities where a ten-acre farm or orchard is able to support a family in comfort, and there are many individual instances wherein five acres have been found sufficient for the needs of a refined family.

In this direction the action of the irrigation convention lately held at Los Angeles, Cal., cannot be too highly commended. The sense of that convention was that the amount of land to be taken up by settlers under the homestead law, in the irrigated sections of the arid belt, be restricted to small holdings. In cases of governmental reclamation of arid districts, the law might well be far less liberal in respect to acres to be entered than at present. If the development be accomplished by private or corporate enter-

prise and capital, every restriction limiting the holding to a small area should be made which might be consistent with the best interests of the particular section.

To prevent large land holdings should be the aim not only of the government, but of any and all persons concerned in the development of the arid region for the best interests of the American people.

But to return to the small colonial settlement. Nothing need be easier, in the way of improving and building up waste places, than to plant in favorable localities small settlements of intelligent, industrious people, according to some pre-arranged plan, and under the intelligent direction of one or more competent persons interested pecuniarily, or otherwise, in the highest success of such enterprises.

The first step is, of course, to secure an abundant water supply, by storage reservoirs or otherwise, and, if necessary, to subordinate other considerations to this prime necessity. With abundance of water under easy control, nearly any of the soils of the slightly sloping plains will be found able to produce abundantly. A settlement or colony may thus be established almost anywhere, due regard being had to the needs of transportation. Such communities, established with forethought, by honest and able promoters, may soon become nearly self-sustaining, if proper attention be given to local manufactures, a matter which has been too often neglected in most of the colonial settlements in California, and elsewhere in the far West.

In some future issue a definite plan for a proposed colony, in an irrigable section of the arid West, may be given, but for the present general reference only is made to the entire feasibility and unquestioned benefits of the colonial system of settling a new country. The theme is an inspiring one, and a contemplation of the beneficent and far-reaching results of proper effort in that direction should fill every American bosom with hope and courage. Whatever may be said by those who have not given this great problem careful consideration, the lands of the United States, now arid and desolate, are certainly destined to become the theater of the highest development of rural industry. These mountain fastness and desert plains are destined to become the happy dwelling places of millions of patriotic Americans, dwelling contentedly in hundreds of tree-embroidered villages, having all the healthfulness of the country, and most of the conveniences and luxuries of the city.

The loftiest ideals of rural life are not only possible here, but readily attainable. Wise legislation and honest exploitation alone are required to plant in the arid West the foundations of a civilization, which shall endure as an object lesson and ultimate goal for the guidance and encouragement of struggling mankind in all countries.

HORTICULTURE BY IRRIGATION.

THE FIG IN AMERICA.

FIGS are produced in a number of the States of the Union, although California is the only State which may be said to send cured figs to market in commercial quantities. The fruit is produced in Florida and adjoining States, as well as in Louisiana, Texas, the Carolinas and a few other places, though from none of these regions are the cured figs sent to market on a large scale, nor does the product command more than local attention. There are some drawbacks to fig culture, even in the localities best adapted to the production of this delicious and wholesome fruit. Experience on the Pacific coast seems to prove that the fig will thrive well throughout the arid belt wherever the temperature does not reach too low a point in winter. On a variety of soils it will do well, though on lands too moist, or not well drained the fruit drops badly or sours, thus seriously affecting the profits of the crop.

For years active efforts have been made in California to produce a fig equal to the best imported article, and with the exception that thus far no fig has been produced on a large scale having fructified seeds, this has been accomplished. The curing and manipulation of figs preparatory to market require the utmost care, and painstaking supervision of an exacting nature. A few growers in California have acquired this art, and as a result put upon the market a fig which is pronounced by many equal to the best imported from Smyrna. We are not prepared, however, to say that this is strictly true, and for this reason: All good Smyrna figs contain numberless seeds, most of which have kernels or meats.

THE SEEDS GIVE FLAVOR.

It is found that these perfect seeds give a characteristic flavor to the foreign fig which the best grown and cured in the United States does not and cannot possess. As stated above, the figs grown and cured in this country do not contain the fructified seeds found in the foreign fruit. The seeds are mere shells and have no kernel or meat inside, thus lacking the flavoring material for the best result in cured figs. Much money and time have been expended in obtaining from the best fig growing districts of Asia Minor the most valued varieties of this fruit, but thus far it has been found that they do not reproduce the perfect seed in this country, much to the disappointment of growers. From time immemorial, indeed, for thousands of years probably, it has been the custom in fig growing regions of Asia Minor and in other

places about the shores of the Mediterranean to cause the fig to be fertilized through the medium of an insect, which we have not yet been able to do successfully in this country. This is accomplished by the entrance through the eye of the fig at a certain period of a small insect known as the blastophaga, or fig wasp. These wasps are bred in a variety of wild fig called the Capri fig, branches of which containing fruit are hung among the limbs of the cultivated varieties. By this means the flowers of the cultivated figs are fertilized, as many varieties of fruits grown in this country are fertilized, through the agency of bees. Although it is disputed by some authorities that the fig wasp is a necessity in the production of the best figs, yet the custom is so universal and of so long standing that it is firmly believed to be necessary by most foreign fig producers.

EXPERIMENTS IN CALIFORNIA.

Efforts have been made in California to establish the blastophaga among the fig orchards of that State, but thus far without avail. Those insects, which were procured at great trouble and expense, did not long survive the conditions to which they were born in the Golden State. Other difficulties also present themselves. It is found that some approved varieties of foreign figs so change their nature when transplanted to this country that the eye of the fruit remains practically closed during the period of possible fecundation, hence it is believed that for such varieties the fig wasp would be of little or no use, even were it able to survive our climate.

The problem, therefore, is to produce a fig which may be fertilized by the methods known to our other fruits, or to acclimate the blastophaga and provide the capri fig for his abode, as in the Old World. That one or other, or both, of these things may be done is believed by some of the most advanced fig growers of the Pacific coast; but that American figs are yet inferior to the best foreign brands in the characteristics above pointed out is well known to our most expert growers and dealers.

As showing the field now open to be occupied by American fig growers so soon as they shall be able to put upon the market an article equal or superior to the foreign fruit, the following figures are given:

For the year ending with June last, there were imported into the United States 10,503,928 pounds of figs, while the home product was below a half-million pounds, most of which were produced in California. Among the best varieties grown in that State may be mentioned the "White Adriatic" and the "Bulletin

Smyrna." The former was imported from Italy, and the latter from Smyrna, by Mr. G. P. Rixford, of the *San Francisco Daily Bulletin*. A number of growers are making money with figs in Central and Southern California, because their methods of curing and packing are so attractive that their product commands a good price, even in competition with the foreign fruit.

FIGS FOR CANNING.

In some sections of the country there is a demand for figs for canning purposes; especially is this demand noted in Louisiana, where efforts are now being made to extend the fig industry, which, to some extent, has long been an industry there. Few of the cured fruits, either domestic or foreign, comprise so large a share of nutritive qualities, combined with a delicious flavor, as the fig. While there should be a very much larger production of good figs in the United States, those wishing to plant on any considerable scale should study carefully the experience of others in different parts of the country, which may be learned from a perusal of *THE IRRIGATION AGE*. Under proper and easily attainable conditions, fig culture may be entered upon with confidence throughout many parts of the arid region, but care should be exercised in the selection of well drained soils and in the varieties to be planted. The fig tree does not require much irrigating water, and many failures have resulted from having figs in the same rows with other fruit trees requiring frequent irrigation, as the orange and lemon. Those who find that the fruit sours and drops from the trees when abundantly irrigated may therefore learn the cause and turn off the water.

THE PRODUCTION OF HOPS.

However much the drinking of beer may be condemned by a great many good people, it is an economic fact of importance that the production of hops for brewing purposes is on the increase. The hop crop of the world last year was about 146,000,000 pounds, of which the United States produced 40,000,000 pounds, or about 27 per cent. of the entire world's crop. Of the crop grown in this country last year, the State of New York produced a little more than one-half, while the States of California, Oregon and Washington yielded most of the remainder. Wisconsin produces a considerable quantity of hops, and the crop is grown to some extent in other States, but the great bulk of the American crop is grown in the States first named. While this is true, it has been found by experiment that hops can be grown with success in a number of the mountain States, including large areas in the arid regions. Census figures show that California has hitherto given the largest yield per acre of hops, and that the other Pacific coast

States fall but little behind her. Yet some experiments in Colorado and other mountain districts indicate that California may be surpassed in the amount of yield per acre by these States wherein the industry has been but little developed as yet. The amount of hops used in Great Britain in 1892 was about 80,000,000 pounds, of which 44,600,000 pounds were produced in British yards, and the remainder imported from the United States and Germany. American hops are gaining in favor in European markets, and with the exception of those grown in certain limited districts in Germany and England, command the best prices in the market.

Although the hop market is subject to considerable fluctuation from year to year, it is believed by many who are engaged in the industry to be a most promising one, and one whose future is reasonably assured. It is one purpose of *THE AGE* to point out from time to time such new industries or modified old ones as appear most promising to those cultivating land in the arid domain, and in pursuance of this object we recommend hop growing as a feature of rural industry where the conditions are found by careful experiment to be best adapted. It must be said, however, that the hop is a somewhat expensive plant to grow, and slipshod methods will scarcely win in its production. But it should be remembered that *THE AGE* does not recognize slovenly methods as likely to win in any pursuit, certainly not in the cultivation of the soil in the arid belt. In engaging in the culture of the hop it will be found advantageous for a number of growers to unite, in order that the quantity produced may attract the attention of buyers, if the district be a new one. In most of the mountain States cheap labor may probably be found for hop-picking among the various Indian tribes and among the Spanish Americans, who are found to some extent throughout this region, and in some places almost to the exclusion of other nationalities. It is found on the Pacific coast that the Indian is especially a valuable factor in the hop yard. Especially in Washington and California are Indians brought into service as hop gatherers, greatly to the advantage of the growers as well as to the Indians themselves. It is a form of labor to which the native son seems especially inclined, but his zeal and faithfulness may possibly be to some extent due to his knowledge that the hop ultimately comes to him in the form of a mild substitute for the firewater of his ancestors. In any event, hop growers avail themselves of this form of aboriginal activity, and the hop gathering season has become one of great moment to the Indian far and near. Great preparations for the work are made, sometimes before the season begins, and the women are seen bustling about in the labors preparatory to the journey of perhaps a hundred miles or more to the hop yards.

TALKS WITH PRACTICAL IRRIGATORS.

REMEDY FOR CURL LEAF.

BY the time this number of *THE AGE* reaches its readers in most parts of the country, orchardists will have commenced or possibly finished the work of early cultivation, pruning and spraying. During the dormant condition of fruit trees is the time when the lime, sulphur and salt wash proves most effective, and it will be found most efficacious if used early on nearly every species of deciduous fruit tree. Elsewhere is given the most approved method of preparing this valuable and inexpensive wash. In this article will be given in brief form a remedy for curl leaf in peach trees. Without going into the origin of the disease unnecessarily, it may be stated that the curling of peach leaves is due to a parasitic fungus which attacks the leaf tissues, and if unchecked will often make short work with a crop of fruit. Until recently no certain remedy for curl leaf had been found; but orchardists may now congratulate themselves upon the fact that this dreaded disease has been brought under subjection by the application of science combined with persistent and well-directed experiments. It is found that if properly prepared and applied the Bordeaux mixture will prove a practical and almost certain remedy against curl leaf. For this purpose the mixture is used effectively in California, Michigan, Maryland and Australia, and the results obtained fully justify the statement that no peach grower should hesitate in its use the moment he detects the presence of curl leaf in his orchard.

PREPARING THE BORDEAUX MIXTURE.

In the preparation of the Bordeaux mixture care should be observed that good, fresh lime, properly slacked, be used. Three pounds of copper sulphate and three pounds of lime, added to 32 gallons of water, make a highly effective spray for curl leaf fungus. In preparing the mixture either cold or hot water may be used, but unless the water be boiling it should at first be added only so fast as taken up by the lime. The trees should be sprayed the first time just before the opening of the leaf buds. A second treatment at the end of two weeks may be required, and even a third spraying may be found to be necessary. Something will depend on the amount of rain that may fall after the spraying. In case of heavy rains soon after treatment, it will generally be found advisable to go over the orchard again after the weather has become settled.

In case it be found desirable to introduce an insecticide for any leaf-eating insects, one pound of Paris

green may be added to 300 gallons of the Bordeaux mixture. This will be found very effective, and the combination will prevent injury to the leaves by the arsenious acid of the Paris green.

It may not be out of place here to urge the absolute necessity of the use of the various approved fungicides and insecticides among which the substances mentioned above hold a high rank. The best fruit can alone be produced upon healthy trees, and trees may be kept in a healthy condition only by the prompt application of proper remedies for any diseased conditions which they may show. The commercial orchardist everywhere must be alert, and as solicitous for the health of his trees as for that of his children, and be prepared at all times to summon and apply the proper remedies on every needed occasion.

So fully do California orchardists recognize the prime necessity of spraying their trees that in some localities efforts toward forming coöperative associations for preparing and administering sprays on a large scale have been made. This is certainly a step in the right direction, for it is manifestly easier and cheaper to have the work done by experts, and in a wholesale way with the most approved appliances.

LIME, SULPHUR AND SALT WASH.

For Winter Use Upon Deciduous Trees for Curl Leaf, Mildew, Etc.

The following formula and directions, if properly carried out, will produce an effective solution:

Unslacked lime, 40 pounds.

Sulphur, 20 pounds.

Stock salt, 15 pounds.

Water to make 100 gallons.

DIRECTIONS.—Place 10 pounds of lime and 20 pounds of sulphur in a boiler with 20 gallons of water, and boil over a brisk fire for not less than ONE HOUR AND A HALF, or until the sulphur is thoroughly dissolved. When this takes place, the mixture will be of an amber color. Next place in a cask 30 pounds of unslacked lime, pouring over it enough HOT WATER to thoroughly slack it; and while it is boiling add the 15 pounds of salt. When this is dissolved add to the lime and sulphur in the boiler and cook for HALF AN HOUR longer, when the necessary water to make the 100 gallons should be added.

Curl leaf and mildew are becoming quite prevalent in parts of the State in unusually wet seasons. The above wash is recommended by the State Board of Horticulture, and should be applied while the trees are dormant.

IRRIGATION BY PUMPING.

By B. D. WHITE.

THAT the results of timely and intelligent irrigation are a rich blessing no well informed person will either doubt or deny.

It might be of interest to many to state the exact distance that their pump carried this water before discharging the same into reservoirs, as well as how many hours during the average day or week their wells can furnish the water and their mills perform the work. These are vital questions in determining the cost and feasibility of an irrigating plant, and to me it seems that a mill and pump of the capacity stated would exhaust a much better well than the average in a very short space of time.

On this coast there are many thousands of first-class mills that are used for raising water which is devoted to stock, household, irrigating and other purposes, and I venture the assertion that 98 per cent. of them cannot perform or accomplish the results claimed. Neither do we claim to possess any ordinary wells that are capable of furnishing a stream of water equal to five or six miner's inches. Now a miner's inch of water in 24 hours will fill a tank of the capacity of 13,000 gallons. Reduce this to minutes and we have a flow of water equal to a fraction over nine gallons. The product of the miner's inch of water when properly stored and used is deemed sufficient to irrigate ten acres of fruit-bearing trees. The value of an inch of water, perpetual flow, is rated from \$100 to \$1,000, according to the locality where situated and the uses to which it is put. In most cases the plants are owned and managed by corporations, who deliver water at points contiguous to their pipe lines, charging therefor from \$5 to \$10 per acre for the season.

On this coast, of the water used for irrigating purposes, not one-tenth of one per cent. of the whole amount is produced through the agency of windmill power. But will it pay a person living within the arid belts of Nebraska to invest in an irrigating plant where water is to be raised by one or more windmills? To answer this question in its varied ramifications would require the intelligence of an oracle, as well as considerable time and space. Wind, like rain, is an uncertain element, and a good supply of the former you must have if you would obtain good results from your investment and labor. Consider (1) the supply of water that your well is capable of furnishing, (2) the force and reliability of the motive power to be used, (3) the total cost of your plant, and (4) your market advantages. In other words, charge to expense account a liberal amount for interest on the whole cost of your plant,

as well as a reasonable amount for wear and tear. Charge also the amount your labor would bring if sold to a thrifty farmer. In brief, charge up all outgoes. On the other hand, carry to your credit page the market value of your whole yield of products, and if it happens to have been a dry year, also credit your plant what the rainfall (which you do not receive) would have been worth to you. Add up your two columns of figures and the difference between the two amounts will determine how much you will be able to *blow in* for some of the comforts of life that are not of frequent occurrence when looked for through the benign influence of old Jupiter-Pluvius.

To those who design building irrigating plants, I would say: First, ascertain if the necessary amount of water can be obtained and at what cost. If the cost does not blacken the eye of the looked for advantages, it will be well to contract with responsible parties for whatever you may require, paying for the same only on *delivery* of the goods. Talk is cheap, and the amount of wind contained within the lungs of a windmill man is sometimes adequate to the turning of his mill, but the water still remains in the bottom of the well.

By means of a walking-beam attachment I am enabled to employ the services of two mills that work two 4-inch pumps, and lift water from the bottom of a never failing well that is 100 feet in depth. One mill is 12 feet in diameter and the other 8 feet, and both work independently of each other. My storage facilities are ample. First tank fills second tank, thence to the reservoir, which is 300 feet distant from the tank house. I irrigate about three acres of vines and trees, and conduct water to three different households. With a greater supply of water returns would be more satisfactory.

Had I occasion to put in another plant, before commencing to do so I would first fully investigate the virtues and adaptability of gasoline engines. I am led to believe that in many respects and under certain circumstances they are the better of the two systems. In my case there is no consolation in knowing that the water which I need is 100 feet below me, my mills stationary and above me, and sportive winking Æolus killing time ogling sea nymphs at Santa Monica or some other festive water resort.

It is said that "there is no cheaper power on earth than windmills." Under certain circumstances and conditions, and up to a certain limit, this claim and statement is seasoned with a morsel of truth. What looks like reasonable and intelligent theory will, when reduced to a partial application, oftentimes prove to be more chimerical than real. Therefore, "Look before you leap."

WATER POWER AND ELECTRICITY.

ELECTRICITY FOR CANALS AND FARMS.

IN the great cities of the world, there are few who are not familiar with the manifold uses to which electricity has been put, and we can safely say that this country holds the palm for enterprise in that connection. Yet to those who have watched its development, it is palpable that the science is yet in its infancy. Books have been written and predictions have been made concerning the wonderful developments which future generations are to witness, and while it is not our intention to speculate on the undoubtedly great results which, in the progress of time, fresh experiments are sure to bring forth, we will notice briefly two very remarkable uses to which electricity has been put during the present month.

At Brighton, N. Y., on November 18th, an official test of electric propulsion for canal boats took place in the presence of Governor Flower and a numerous and distinguished company, and was a pronounced success. The experiment was made with an ordinary canal boat, which had been fitted up with motors and trolleys like a street car. The machinery and motor worked perfectly, and at times a speed of eight miles an hour was attained. The boat was crowded to its full capacity, so that the test might be complete. The only difficulty lay in keeping the boat in a sufficiently straight line to keep in connection with the overhead wires, but this can be easily remedied by the use of flexible trollies, so that the boat can be moved from the bank as well as midstream.

When generally adopted, the use of electricity as a motor power will effect a revolution in canal traffic. At present, there are, in round numbers, 3,000,000 tons of merchandise sent through annually, from Buffalo to New York, on canal boats. We do not think Governor Flower over-estimated the mark when he said that with a perfected electric system the traffic would reach 12,000,000 tons. It is, indeed, a great change from horse and mule power, and from a speed of two miles to one of eight miles per hour. It is estimated that the expense of operating by electricity will be only half that of steam.

ELECTRICITY AS A FERTILIZER.

The Montbrison Society of Agriculture, in France, has decreed a silver medal to Brother Paulin

for his invention of the geomagnetifier. These consist of a resinous pole forty or sixty feet in height, supporting an insulated galvanized iron rod, terminating on the top in five branches of copper. This attracts the electricity generated by storms, etc. At the bottom this collector of electricity communicates with a system of iron wires, spaced 6 feet apart and buried in the ground, and which distributes the fecundating fluid through the arable soil to be influenced. This installation will last for several years, and a height of 50 feet is considered sufficient for 30 acres.

In one experiment over a radius of 65 feet, planted with potatoes, the stalks grew to an extraordinary size, and preserved their verdure and freshness for an exceedingly long time. There were produced in an influenced section of 2 quadrilaterals each of 50 feet superficies 198 pounds of tubers, where an uninfluenced one produced but 134 pounds. At this ratio, an acre fertilized with electricity would give 30,800 pounds, to 20,370 pounds in the uninfluenced acre. This result was obtained without special manuring, and from a potato of feeble rendering. Equally successful experiments have been conducted in the case of vines, celery, radishes, spinach and sugar beets. If the success which attended these experiments continues, the use of electricity as a fertilizer is destined to be of momentous importance to the wide-awake farmers of this country. Competition has grown too keen for such a powerful agency in inducing crops to be overlooked or neglected. Nature certainly provides us with plenty of electricity. If anything, our farmers have rather a grudge against her on that score, and will be glad to avail themselves of the geomagnetifier to help them in crying quits.

ELECTRICAL EXPERIMENT STATION.

A bill has been introduced in Congress by Senator Peffer, providing for the establishment of an experimental station for testing the use of electric power for farm implements and machinery, to be under the supervision of the secretary of agriculture, and an appropriation of \$10,000 is named for the first year's expenses in putting the plan into operation.

PUBLISHER'S DEPARTMENT.

RESOURCES OF KERN COUNTY.

IF the reader will consult any easily available map of California he will find that the greater portion of the Golden State is comprised within a vast, oblong valley, extending north and south for a distance of six hundred miles, bordered on the east by the Sierra Nevada mountains and on the west by the Coast range.

These ranges approach each other both at the northern and southern extremities, finally uniting in one grand semi-circular sweep.

In the extreme southern portion of the valley is located KERN COUNTY, to a few of the prominent features of which the attention of the reader is invited, presenting, as it is believed that it does, superior attractions to people of all classes who may be desirous of changing their location from any reason whatever.

In area this county is somewhat larger than the State of Massachusetts, and it comprises a widely diversified region, including a vast extent of level and fertile valley, succeeded by rolling foothills, and extending into lofty and rugged mountains, which are in turn pierced in various directions by canyons and valleys, containing more or less arable land.

Not an inconsiderable portion of the county extends into what is known as the Mojave desert, where are found rich mines of gold and other minerals.

THE CITY OF BAKERSFIELD.

The principal town and the county seat of Kern county is Bakersfield. It has upward of 4,000 inhabitants, and is situated on the main line of the Southern Pacific railroad, a little over 300 miles south of San Francisco and about 170 miles north of Los Angeles. It is the largest place between Fresno and Los Angeles, a distance of nearly 300 miles, while its tributary territory is so vast and so abundantly endowed with natural resources that it must always be the center for a great and important trade.

While an old place, as California towns go, Bakersfield is largely composed of modern style brick buildings and will compare favorably with any town in the State from this standpoint.

So far as churches, schools and societies are concerned, Bakersfield is well supplied and all classes are fully represented.

Bakersfield is now the division headquarters of the Southern Pacific road, and no line of railroad can enter the valley without coming to this place. It commands every pass through the mountains that sur-

round the valley on three sides, and is absolute queen of the situation.

It is the universal testimony of those who are so situated as to be able to judge that there is no town in the State that has a brighter and more assured future than Bakersfield.

CLIMATE AND RESOURCES.

The climate of Kern county partakes of the same general characteristics as that of the greater portion of California.

The summer season is long, warm and dry. It is what experience has shown to be most admirably adapted to the growth and perfection of all kinds of deciduous fruit, and to its ready and perfect curing in the open air without the aid of artificial heat.

The rainfall is confined to the so-called winter and spring months, distributed at intervals from November to April, and occasionally later. The mercury rarely goes as low as 25 to 30 degrees above zero, and the winter average is much higher.

In natural resources Kern county possesses a wide range and a surprising abundance.

The soil of the valley will produce in luxuriance all the deciduous fruits and nuts known to the State; all the vegetables, all the cereals, all the root crops, all the small fruits, all the forage plants that are raised in the temperate or sub-tropical zones. Not only can these be produced, but they actually *are*.

The mountains have valuable forests of pine and other timber, while deposits of gold bearing gravel and quartz of great richness are now being, and have for years, been worked.

In the foothills of the western part of the county are the largest and purest deposits of asphaltum in the world. Oil and sulphur are also found there in abundance.

HORTICULTURE.

It is only within a comparatively short time that horticulture has received more than desultory attention in Kern county. Yet enough has been accomplished within a few years to conclusively prove that for the production of deciduous fruits of fine quality and in great abundance, there is no portion of the State that can surpass this.

Suitable climate is the *sine qua non*, without which the best soil in the world is fruitless. In Kern county is a combination of both soil and climate which causes the wide range of fruits produced to excel in every quality that makes a choice article.

Especial pains have been taken to experiment with as great a variety of fruits as possible, and failure in any respect has yet to be noted. The success achieved has in fact been phenomenal.

Particularly is the climate adapted to the perfect curing of fruit in the open air. All that is needed is exposure of the freshly cut fruit to the sun's rays for three to five days, the resultant product being uniformly of bright color, good texture and appetizing appearance. A large part of the fruit crop of this county must be prepared for market in this way, and the Kern county horticulturalist enjoys peculiar advantages.

THE PEACH.

At the head of the list of horticultural products in Kern county, because most extensively cultivated, is the peach. In every concomitant of soil and climate which enters into a combination of those elements that are necessary for the production of a perfect peach, Kern county reigns supreme. Without fear of contradiction it is maintained that this section has no superior, if indeed it has an equal, in this branch of horticulture.

The trees of whatever variety grow thrifily, are remarkably free from disease, bear early, produce large, highly colored and luscious fruit, and at the same time are long lived. Instead of early maturity producing early decay, the reverse appears to be true, and the peach is long lived and prolific.

At two years from planting in the orchard a fair yield has been known, while at the age of three years good sized crops are the rule where the proper methods of cultivation are followed. From that time onward until full maturity the product increases, until it reaches a point that is astounding. Ten tons of the fresh fruit to the acre are not uncommonly harvested from a full grown orchard.

The profit in peach growing depends upon conditions that vary each season. It has been known to reach as much as \$400 an acre and even more, but is usually much less. It is a conservative estimate to put the net return from a mature peach orchard, one year with another, at an average of \$100 an acre.

Bakersfield, California.

High Arm
Warranted
Ten Years.



FREE TRIAL in your own home for 30 days without paying one cent in advance; machine to be returned at our expense if unsatisfactory. We take all risks, pay freight, ship anywhere, to anyone, in any quantity at wholesale prices. \$65 Kenwood machine, \$24.50; \$85 Arlington, \$20.50; \$45 Arlington, \$17.50; \$35 High Arm Gem, \$12. We sell all makes and styles, from cheapest \$7.95 to best "Kenwood," \$24.50. All attachments free. **THANX HIGHEST WORLD'S FAIR MEDALS AWARDED.** Over 100,000 now in use. Buy direct from factory. Save agents' large profits. Catalogue and testimonials free. Write at once. Address (in full) **CASH BUYERS' UNION, 158-164 W. VanBuren St., Dept. A31, Chicago, Ill.**



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Only the Scars Remain.

"Among the many testimonials which I see in regard to certain medicines performing cures, cleansing the blood, etc.," writes **HENRY HUDSON**, of the James Smith



Woolen Machinery Co., Philadelphia, Pa., "none impress me more than **my own case**. Twenty years ago, at the age of 18 years, I had swellings come on my legs, which broke and became running sores. Our family physician could do me no good, and it was feared that the bones would be affected. At last, my good old mother urged me to try **Ayer's Sarsaparilla**. I took three bottles, the sores healed, and I have not been troubled since. **Only the scars remain**, and the memory of the past, to remind me of the good

Ayer's Sarsaparilla has done me. I now weigh two hundred and twenty pounds, and am in the best of health. I have been on the road for the past twelve years, have noticed **Ayer's Sarsaparilla** advertised in all parts of the United States, and always take pleasure in telling what good it did for me."

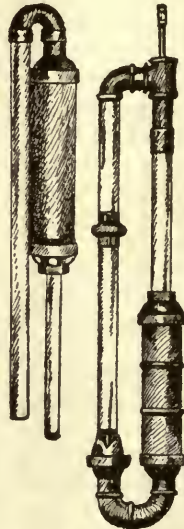
For the cure of all diseases originating in impure blood, the best remedy is

AYER'S Sarsaparilla

Prepared by Dr. J. C. Ayer & Co., Lowell, Mass.

Cures others, will cure you

THE CRANE PUMP.



Chas. A. Crane has invented a new pump. Unlike the present pump, the cylinder is placed at the bottom of the well and is inverted, taking water at the upper end of the cylinder, and discharging it through a pipe leading from the lower end of the cylinder to the tank or receptacle prepared above ground. By this means the water is forced at all times, and in the down stroke the rod operates as a balance against the column of water, thus reducing the power. It is proposed that this pump will raise double the amount of water than any ordinary pump with the same expenditure of power. The pump can be put in any well, any depth, and will work in deep or shallow water. It is especially a wind mill pump, and can be manufactured cheaper than any other pump on the market, and is a good pump generally.

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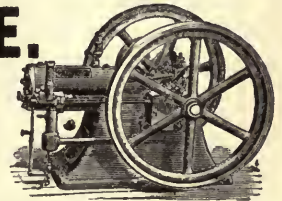
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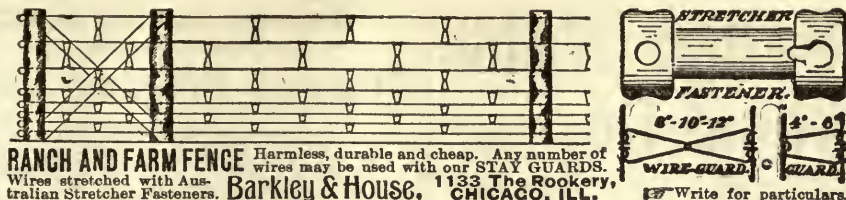
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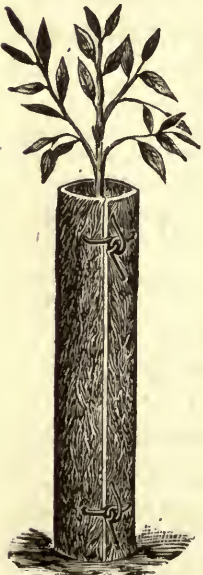
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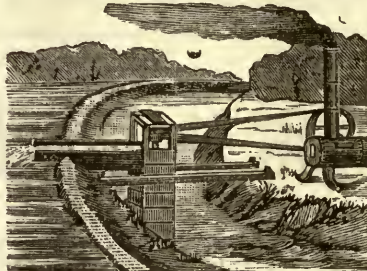
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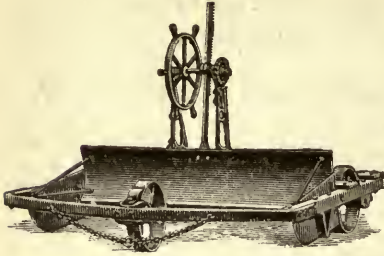
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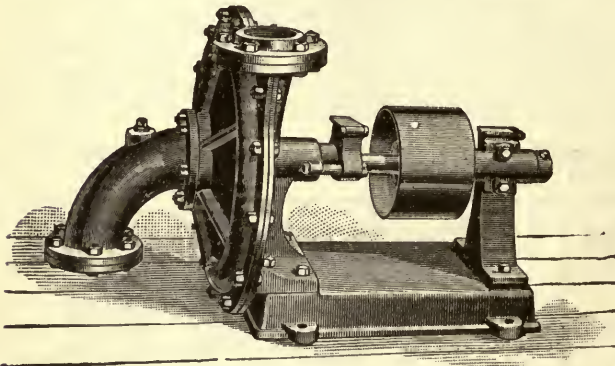
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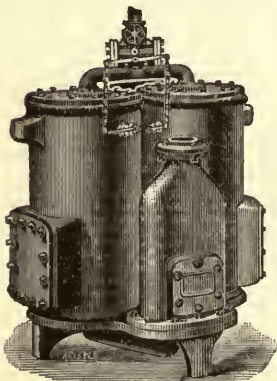
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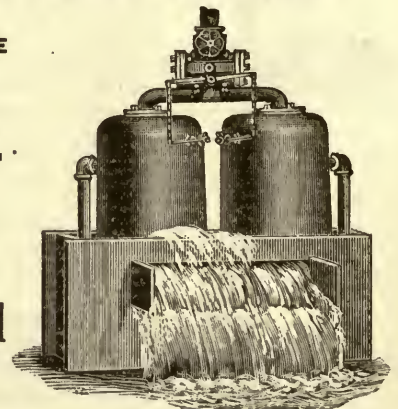
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MENTION THE AGE.

Pilgrim Fathers of Today



THE SPECIAL PULLMAN TRAIN

— VS —



The Prairie Schooner.

THE making of America began with the arrival of the first colonists on the shores of Plymouth bay. And from that day down to the present hour the colonist has been carrying the flag of civilization into new countries and founding new institutions. When the Atlantic was fringed with settlements the pioneer pushed across the Alleghanies, conquered a new wilderness and carved more States from the forest and prairie. The last great colonization epoch was the movement of a generation ago, when the dissolving armies of the Union peopled the Mississippi valley and covered the country with new farms up to the point where the rainfall vanishes and aridity confronts the settler with a new problem. It is less than a generation since the days of the prairie schooner were at their height. The life of the colonist may have lost something of its picturesqueness, but it has gained much in comfort, and it is a very interesting thing to compare the scenes of the recent past with what is going on to-day in the making of new homes in new countries.

THE GENERATION OF THE PRAIRIE SCHOONER.

The prairie schooner was the emblem of the homestead era. The pioneer made his covered wagon a house on wheels and gathered into it his wife and children and all the household belongings necessary for the new home. Whatever he possessed in the way of surplus horses and cattle were driven before him, and the indispensable dogs trotted contentedly behind. So equipped, the pioneer and his family set out for the great, mysterious West, where land was cheap and plenty and the rough life of the frontier was sure to be liberally spiced with adventure. This was the common method of making the journey, even after the transcontinental railroad marked an iron pathway over the prairie, for the larger portion of the quarter sections must necessarily lie far away from the usual route of travel.

THE IRRIGATION AGE.

Most of the children born in prairie schooners have yet to cast their first vote for president; but when we compare the colonist of to-day with his prototype of the Mississippi valley the era of the prairie schooner seems almost as remote as that of the Mayflower. It is not alone in the manner in which he travels that the modern colonist differs from the settler of 1874. Equally striking contrasts are presented at many other points, but let us begin the comparison here and carry it through to the end.

SOME PILGRIM FATHERS OF TO-DAY.

On March 13, 1894, a party of modern colonists set out for our modern West from the city of Chicago. Some of them came from the classic shades of New England, some from the busy life of New York, and many from the great metropolis by Lake Michigan. As this is not a romance, but a true story, we will append a complete list of the particular party of Pilgrim Fathers referred to:

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PILGRIM FATHERS OF TO-DAY.

PIONEERING IN A PULLMAN SPECIAL.

These modern colonists proposed to seek homes at a distance of more than three thousand miles from where they formerly lived, and yet they did not look forward to the journey with anything like dread. The colonist of a generation ago made fifteen or twenty miles a day in his prairie schooner. Days ran into weeks and, frequently, weeks into months before he finally found anchorage for his ship of the plains. These latter-day colonists had but four days and nights between them and their destination, though many States were to be crossed and the boundary of a foreign country paralleled for a long distance. Instead of a covered wagon they embarked in Pullman sleeping cars, which offered every modern convenience known to the most luxurious home. The sleepers "Netz" and "Ophir" and the elegant dining car "Occidental" comprised the special train in which the third excursion of the Lake View Land Company set out for the most delightful corner in all Arid America—Southern California.

The head of the party was the captain of many such expeditions, Mr. Frank E. Brown, who made his reputation as the father of Redlands, the most beautiful and successful of all the orange colonies in the paradise of the far Southwest. There is a certain indefinable fellowship between the parties to such an expedition as this, who are leaving established communities in the East to make their homes together in a new



IRRIGATING AN ORANGE NURSERY.

THE IRRIGATION AGE.

land and under new conditions. The reasons which impelled them to make so radical a change in their mode of living and place of residence are widely different, but they share common anticipations, and the life of the new colony really begins when the train rolls out of the Chicago depot. Here is another contrast to be noted, for the life of the prairie schooner was a sort of isolation from the start, and the first months on a bare quarter section of prairie were shrouded in loneliness. The neighborly character of these Pullman pioneers, on the other hand, will only be perpetuated and deepened by the conditions surrounding life on the small farms of California. The trip from Chicago to Redlands was like a delightful holiday, filled with the pleasures of travel through new scenes and flavored with a pleasant social atmosphere. The route lay through St. Louis, Little Rock, Texarkana and San Antonio, where the party enjoyed a carriage ride, visiting the historic Alamo and the government post. Then on to El Paso, where the excursionists crossed the Rio Grande river into Juarez, Old Mexico. Then they passed on through southern Arizona, across the famous Colorado desert, into sunny Southern California proper. They beheld its valleys and mountains for the first time in the light of a full moon as they arrived at Redlands just before midnight, Saturday, March 17th.

THE MIRACLE OF REDLANDS.

But it was not until Sunday morning that the full beauty and grandeur of the locality was revealed to them. It was a perfect day, and the rare picture of white old winter in the mountain tops, and green, prosperous summer in the irrigated valleys, was presented at its best. Sunday forenoon was devoted to a thorough inspection of the town and its outlying colonies which the president of the Lake View Land Company created, largely by his individual enterprise, a few years ago. To those who have seen Redlands it is unnecessary to describe it; to those who have not, it is impossible. But it is a type of the best that nature and man can do in the way of uniting the practical and the beautiful in colony making. It is the product of irrigation. Every tree and flower tells the story of the miracle of water when applied to the rich but arid soil of the desert. The homes and orchards of Redlands were thoroughly inspected by the new comers, and nothing pleased them more than the beauties of Smiley Heights, which the water Mr. Brown caused to be stored in the mountain top has transformed from a bare mesa, furnishing but poor pasturage for sheep, into one of the now most charming estates in the world. Sunday afternoon the long line of carriages crossed the hills into Alessandro valley and put up for the night at the Hotel de Moreno. Bright and early Monday morning the party set out for the new colony of Lake View.

FINDING WATER FOR LAKE VIEW.

No longer ago than last September the tract of ten thousand acres,

THE IRRIGATION AGE.

VOL. VI.

CHICAGO, APRIL, 1894.

No. 4.

THE PROGRESS OF WESTERN AMERICA.



THE LATE HON. ANDREW GILCHRIST,
Of Cheyenne, Wyoming.

The Outlook for Silver. The men of the West are digging for gold in these spring days, but they have not forgotten the silver issue. Nine months ago they were talking and fighting for free coinage. To-day, in the opinion of the friends of the white metal, free coinage is working out its own solution. What the men of the West and South fought for unsuccessfully at the extra session of Congress, the silent forces of commercial economics appear now to be fighting for with better prospects. Depression is universal, and as time goes on the demand for a larger volume of money increases. The German emperor has appointed a commission to investigate bi-metallism. The London Chamber of Commerce has petitioned the new premier to convene the International Monetary Conference. The financiers of India are calling for relief from the single standard, and Congress has passed a bill providing for the coinage of the seigniorage. No-

body now pretends that the repeal of the Sherman law helped matters financially. Those who explained in advance how money would be made more plenty by making it more scarce have observed that their theory fails to connect. The men of the West will bide their time. If the world wants gold they will mine it. If it wants silver, it will be forthcoming.

The Late Andrew Gilchrist. A severe loss has fallen upon Wyoming in the death of Hon. Andrew Gilchrist, of Cheyenne, the last honor of whose life was his recent election as a member of the State Irrigation Commission. It is a saddening thought that the forthcoming report of that body will miss the impress of his clear and vigorous mind, and that the State he loved so well will be deprived of the benefit of his wise counsel in framing its demand for a new national policy. Mr. Gilchrist was a type of a certain sturdy element in the citizenship of the West which is the mainstay of its growing civilization. He was one of those men who acquire large means, locate in a new country, settle down deliberately to the work of building it up, and then never turn their faces backward, no matter what difficulties and disappointments may be encountered. These are the men who make progress possible, nay, inevitable. Very frequently, as in this instance, they *say* little, but they *do* much. Mr. Gilchrist was largely identified with the important cattle industry of Wyoming, but he was not of the element that sees no future, and desires none, except the increase of herds. His large investment in the Wyoming Development Company—the most important irrigation works in the State—is evidence that he not only desired to see the farmer replace the steer, but that he was willing to risk a daring investment in order to make the result possible. A man of pronounced convictions and plain words, Andrew Gilchrist had human sympathies as broad as his intellect was clear and his frame sturdy. He will be long remembered as a man of honor and public spirit, as one of the builders of the commonwealth. Although he seriously differed with the writer on a memorable occasion, THE IRRIGATION AGE reverently bows to

the honored memory of one who loved with impartial affection every part of that great West in whose destiny he so profoundly believed. Prof. Elwood Mead writes as follows of Mr. Gilchrist's relation to the industrial and political life of Wyoming:

In the death of Andrew Gilchrist, Wyoming loses one of her most upright and influential citizens, and the cause of irrigation one of its most consistent and intelligent friends. A member of the original Greeley colony, and one of the first settlers in that important attempt at reclaiming the desert, he has ever since taken an active and honorable part in promoting the reclamation and settlement of the arid West.

One of the first of the influential stockmen to realize the transitory character of the open range live stock business, he was one of the pioneer ditch builders to provide a winter's food supply as a safeguard against winter storms. His interest in irrigation, his zeal in its extension embraced, from the first, far more than its relation to his personal affairs. No man in the West had an earlier or more correct conception of its future possibilities, of the part it is to play in furnishing homes for the homeless and in adding to the material wealth and prosperity of this region.

A member of the Legislature which enacted the first territorial water law, he was, if not its author, one of its most active advocates, as he was one of the strongest supporters of all subsequent legislation on this subject. Believing thoroughly in the agricultural future of the State, he not only gave his influence, but invested his means in enterprises for its promotion. One of the builders of the Boughton canal, the builder and owner of a half-dozen ditches watering his home ranch of 20,000 acres, and the president, and for ten years the active manager, of the Wyoming Development Company, he has made a generous contribution to the material development of the State. It is in connection with the last named company that he will be longest remembered. A colonization enterprise involving an outlay of a half-million dollars before there could be any return, and intending to reclaim land in a region where the financial success of agriculture was regarded at the time as problematical, was an undertaking which required a more than ordinary measure of faith; a faith destined to be tried by a controversy with the government which for six years delayed the carrying out of the company's plans after the lands were ready for settlement.

It was only given to him to see the beginning of the fruition of his plans. The beginning of actual settlement only began this year, but the number who have already found satisfactory homes, the influence it has already exerted in promoting settlement elsewhere and the increase in population and wealth to the section concerned will always make this pioneer colony a notable factor in the State's history, worthy to be compared to the influence of the Greeley colony on the growth of Colorado.

No one could be intimately associated with Mr. Gilchrist without becoming impressed with the patriotic loyalty which he felt toward the State of his adoption. Born in Scotland, he manifested toward the home of his mature years all of the loyal attachment, the desire for its growth, the preservation of its institutions which is so conspicuous a feature in the attachment of his countrymen to the land of their birth.

With the present number THE IRRIGATION AGE enters upon the fourth year of its publication. Its history has been like that of many other newspapers which have fought their way through difficulties to success. It is not easy to establish a publication in any field, and especially in a new field, whose possibilities are unknown, where there are no standards to follow, and where a new class of literature has virtually to be created. But few things in this world worth doing or having

are easily done or acquired. After many vicissitudes, THE AGE is permanently established in the great city of the West, its circulation and influence radiating to every part of the world where the English language is spoken. It seems ready at last to rapidly approach the ideal of its founders. It aims to be the distinctive journal of western America, to be both the inspiration and the historian of the great energies which are making institutions in the empire where water is king. It is conscious of many shortcomings, but these will be remedied as rapidly and fully as possible. The thanks of the publishers are due to many steadfast friends who have never, since the first number appeared, faltered in their loyalty to THE AGE.

Colorado's Secession Canard. The story which was so widely telegraphed over the country, to the effect that petitions were in circulation in Colorado mining camps asking for the annexation of that State to Mexico, was, of course, promptly shown to be a hoax. There is no disloyalty in Colorado, nor in any State or Territory of the West. On the contrary, the deepest and truest Americanism prevails there. It has been charged against the West, as a rampant favoritism, that its people believe so profoundly in the power and greatness of this nation as to assert that it can make the world follow its initiation of a new financial policy. The East does not believe this country is so great as that, and this is really the only important ground of difference between the two sections. The West errs, if at all, on the side of being unreasonably American. It is unwilling to agree with the East that any foreign nation can exert more power in the councils of the world.

They Want to Join Wyoming. Several of the westernmost counties of Nebraska have declared that they desire to be annexed to Wyoming. The ground of the demand is that irrigation is vital to their prosperity; that the people of Nebraska take slight interest in the subject, while Wyoming has model laws and a live administration policy. There is much reason in the demand. In fact, the reason is so plain as to be rather startling in its suggestiveness. The line that divides the humid regions from the arid lands, both as to the States and as to the nation, marks off sections that differ radically in their necessities and promise to differ much in the character of their social and industrial institutions. Irrigation laws and policies are vital in one locality, while it seems ludicrous to the inhabitants of another locality to talk about them. As civilization develops it will be difficult for the people of two sections, with such radical differences, to live under the same laws, unless the people of the rainy part will put down their umbrellas long enough to see the clear skies in the arid portion. This promises to be the case in Nebraska, where the interest just now taken in irri-



LOS ANGELES COUNTY, CALIFORNIA, THE HOME OF THE ORANGE AND LEMON.

gation would appear to be sufficient to guarantee proper attention to the needs of the people of its western counties.

A Proposed Texas Measure.

The awakening of irrigation interest in Texas is very marked. It seems certain to accomplish important results in time. One phase of it is the discussion of proposed irrigation legislation. F. E. Roesler, of Dallas, contributes to the *Texas Ranch and Farm* the rough draft of a measure which would provide for irrigation district works by a unique method. He would have a State Irrigation Board, composed of the governor, auditor, treasurer, attorney-general and insurance commissioner. This board would pass upon the feasibility of district works, which should not be undertaken un-

til duly authorized by a two-thirds vote of the people living in the proposed district. After favorable action, first by the district, and second by the State board, bonds would be issued to the amount of the estimated cost of the work and turned over to the State. The State board would then construct the works for the district, using convict labor for the purpose. The bonds would be payable in equal installments over a period of fifty years. Estimating the average cost of reclamation at \$5 per acre, the annual assessment for payment on principal would be 10 cents, and for interest 25 cents at the beginning, decreasing each year. Probably \$1 per acre would cover the bond charge and expense of maintenance, and Mr. Roesler thinks there is no question but that irrigation is worth \$1 per acre every year to

every farmer in western Texas. The proposed bill is quite elaborate and provides ample safeguards at every point. We have here sketched only its broad outlines.

Its Strength and Weakness. The author of this new sample of constructive statesmanship proposes to call a convention and submit his idea to his fellow citizens. We shall read the proceedings of such a convention with great interest. Like most radical legislation, the bill has elements both of strength and of weakness. It is, of course, in the line of paternalism and will encounter the prompt and vigorous opposition of those who jealously guard the field of private enterprise against encroachment by the Government. But this feature will attract support as well as foster opposition, for there is a large and growing element in this country which believes in the policy of public works, especially in the case of enterprises that deal with natural monopolies. Then there is the ever ready opposition to the use of convict labor, and the number of honest men now out of employment will give unusual force to the argument at this particular time. The strength of the proposition lies in the fact that it proposes to tax only its beneficiaries; that it involves the use of comparatively little cash capital, and that it distributes the cost over so long a period as to render it a burden that will scarcely be felt at all. A study of the workings of the California district law will reveal certain weaknesses that have not been referred to in this connection. But we would like to see the Texas idea have a trial. Western Texas ought to irrigate. Either private or public works will pay. The thing is to get water, to divide big farms into small ones, to diversify the crops, so that, come what may, every industrious family will be sure of a living. We hope Mr. Roesler will keep at it. Some day he will have a monument.

Herbert Heywood on Arizona. Mr. Herbert Heywood, the well-known correspondent of several of the most prominent daily newspapers in the East, has been writing a series of entertaining letters from the far West. He dealt with Utah and New Mexico without arousing any conspicuous evidence of resentment on the part of the people described, although his letters were written with much candor, and made no attempt to conceal such unfavorable impressions as he received. But in the case of Arizona his comments aroused a storm of criticism not unaccompanied with abuse on the part of certain newspapers and individuals. The writer is well acquainted with Mr. Heywood and knows him to be very much of a gentleman, as well as a writer of ability and reputation. We are quite sure he would not attach his signature to a statement which he did not believe to be true, and yet we do not blame the Arizona public

for its prompt and vigorous reply to his articles, nor do we at all agree with the very unfavorable conclusions which he has spread before his army of eastern readers. We do most emphatically dissent both from the matter and the method of the personal abuse that he has received, and most earnestly advise the Arizona public to adopt a different policy in dealing with persons of influence at such critical times as the present. This we consider good advice for reasons of policy, though there are better reasons which should restrain self-respecting men from indulgence in personal attacks in ordinary cases.

The Case Against Statehood.

Mr. Heywood's letters charge that Arizona is seeking Statehood under false pretenses. He asserts that a majority of her people do not wish to see the Territory become a State; that her administrations have been a succession of black corruption; that she has grossly exaggerated her wealth and population; that she is on the verge of bankruptcy, and will collapse financially under the burden of State expenses; that her population is steadily decreasing. This is Mr. Heywood's case against Statehood, and the eastern press has made most of it. The picture is a trifle gloomy as one looks upon it through Mr. Heywood's eyes, but there is very little to it after all. It is true that there has been corruption in Arizona. So there always was, and always will be, while the high officials are appointed by a power two or three thousand miles distant from the locality to be governed, and especially when political ne'er-do-wells are shouldered upon Territories to pay the campaign debts of Washington politicians. The best way to stop corruption is to let the people govern themselves—to render their public officers accountable to the people who made and unmade them, rather than to the president of the United States. The statement that the majority of the voters of Arizona do not want Statehood is unworthy of consideration in view of the fact that the man these same voters have sent to Congress, again and again, is demanding, in their name, that the Territory be admitted into the Union. Mr. Heywood's opening sentence answers the assertion quite fully: "Arizona *wants* to become a twinkling star in the national flag's field of blue." That is precisely what Arizona wants. In like manner Mr. Heywood has answered all his other charges about lessening wealth and decreasing population, for his final sentence reads as follows: "At the present rate of progress in development there is no doubt but in a few years she (Arizona) will make valid her claims to Statehood." Now, Mr. Heywood cannot mean that after Arizona has got more into debt, after she has lost more of her cattle and mining industries, and after her population has dwindled to a few Pima Indians, "she will make valid her claims to Statehood."

If his previous assertions were entirely sound the conclusion would be that in a few years Arizona would fall into the hands of the commissioner of Indian affairs. No, Mr. Heywood really perceives the great and certain future of the coming State, and entirely forgets the wall of impossible arguments on which he has sought to build up his case against political freedom for Arizona.

The Mistaken Eastern View. We do not mean to intimate that he writes other than sincerely. He writes as the editors-in-chief of his several papers, and the other leading citizens of prominent eastern towns would have written if they had been in his place. He represents the common eastern view of a pressing western problem. It is a view which



C. A. GREGORY, OF NEW YORK.

forgets the past and closes its eyes tightly against the future. It is unfair, but not intentionally so. This mistaken eastern view is erected, first, on the erroneous assumption that population is the supreme test of fitness for Statehood. To believe that this is true, and that Arizona's present population is insufficient to entitle her to be admitted, is to close one's eyes to the history of state-making in this country. Population is not to-day and never has been the test of fitness. If it were, how could Delaware, with 168,493, enjoy an equality with New York, having a population of 5,997,853? Does anybody propose to deprive Delaware of her sovereignty? Does anybody doubt that Arizona's capacity for growth is more than Delaware's? Of course not. Many States have been admitted with less people than Arizona has to-day.

Population is not a test. It never has been. Geographical divisions, conveniently located for government from a common point, have been repeatedly made into States. In the East these divisions are generally small, and in the West generally very large, but the idea of making a State or a locality susceptible of being properly governed from a central point, and a locality whose people have common interests, has been the rule of action from the beginning. These States have been given equal representation in the Senate in token of their sovereignty, but in the popular branch, and in the choice of president, they have been measured simply by the number of their population. In this way the great experiment of combining many independencies under one nationality, without prejudice to the rights of either, has been carried to success. Those who favor the admission of Arizona are in the line of their country's traditions, and those who oppose it are taking a new and dangerous step away from that safe ground on which union was alone possible at the beginning. In the presence of this great fundamental doctrine of our institutions, how paltry and puerile sounds the talk about the amount of money invested in mining machinery and the number of main and lateral ditches that are in existence! Massachusetts, Michigan, Nebraska, California and all the rest, from ocean to ocean, from lakes to gulf, came into the Union of States upon higher grounds than these. So will Arizona. All these States—even the much-abused Nevada—have paid their way and maintained their integrity. Most of them have grown with the coming of State pride and political freedom. Arizona will do the same, and ten years hence the men who now oppose her admission, contemplating as they will then the wonderful expansion of her population, industries and wealth, will ask with some curiosity why they arrayed themselves against the men who went out to conquer another American commonwealth from the wilderness—another white star for the field of blue.

Irrigation Journalism.

One of the best indications of the rapid growth of popular interest in irrigation is the birth of new journals devoted to the subject. Three new ventures of this kind saw the light for the first time in March, making a total of eight that have been started since *THE AGE* appeared three years ago. None of the new ones have yet lived to an important age, but there can now be no doubt that, sooner or later, there will be a number of flourishing newspapers of this kind. When this hope is realized, *THE AGE* will be entitled to wear a new distinction—father of a school of journalism. To found a newspaper that survives is a creditable thing, but to create a literature and a new class of journalism is a famous thing, for it means that history and institutions are to be made. We hope all the new comers in the field of irrigation journalism will live and prosper and do good. They are creditable to editors and publishers.



IN IRRIGATED NEW MEXICO. THE ROAD FROM LAS CRUCES TO MESILLA.
(By permission of the New Mexico Bureau of Immigration.)

The Omaha Convention. The convention of the Inter-State Irrigation Association, which is in session at Omaha as we write, is one of the significant events of the year. This association is a part of the complete and effective machinery of a great and widespread movement. The movement, strange as it may seem, is in a sense the offspring of an impulse which found its first vigorous expression at Omaha. We do not refer to irrigation as an industry—the legacy of the Mission fathers of California and the Mormon pioneers of Utah—but to irrigation as a living public question, having leaders and followers, a literature and an organized propaganda. And in this phase the movement was born of that sinister parent, the drought, and sprang from the blighted fields of western Nebraska in the memorable summer of 1890. During that trying period, when nearly everybody prescribed charity as an antidote for disaster, a newspaper in Omaha prescribed irrigation. The result of its vigorous agitation was the holding of four county conventions. These led to a State convention, that in turn to the National Congress at Salt Lake, and the latter to the International Congress at Los Angeles. And hence the present organization, with National Committee, State Commissions and auxiliary associations, comes in direct descent from Omaha. There were agitators and agitations before, but the hot winds which devastated the crops of 1890 bore the inspiration which led to the solid and enduring movement of to-day. The meeting at Omaha, marking the rising tide of irrigation interest in the semi-arid region, was therefore peculiarly appropriate. It was a successful and inspiring meeting, the results of which seem to promise a great good for the country between the Missouri river and the mountains.

The Movement to Irrigated Lands. The movement of population to irrigated lands is the most striking feature of progress in Western America during the early months of 1894. Looking back to a year ago, it is observed that there was then no indication of so strong a current in this direction as has now set in. And yet many circumstances have suddenly conspired to make the movement quite irresistible and to extend it over a wide area. First of all, this development is due to the prevailing hard times and uncertainty. Thousands of people have suddenly awakened to the truth that no family which depends upon others for employment, and hence for its living, is in the best sense independent. When the panic comes the factory closes. The well-to-do lock up their capital in the bank and wait for business to be restored to normal conditions. To them the closed factory means loss of interest. But the man whose capital is in his brains and hands cannot lock it up in the bank. He continues to eat, to pay rent, and to

buy clothes. He cannot wait with patience for the slow processes of the business world to bring prosperity back to him, because while he waits he is carried nearer and nearer, day after day, to the point where his family must finally come to want. We are not thinking now of the very poor, to whom the loss of a day's work means privation, but of the great, substantial middle stratum of our citizenship, which lives well and lays up money on the earnings of skilled labor when times are normally good. This class has not yet gone hungry or naked, but it has taken time to think, and has clearly read the lesson which only such a period as the present can reveal. This lesson is that the farmer who produces what his family consumes, independent of tariffs, financial policies, and even of the uncertainties of weather, is after all the only really free man who lives upon the earth.

Good Material for Citizenship. What sort of material for citizenship shall we find in skilled mechanics from the factory, clerks from the banks and stores, and people drawn from various walks of life in the myriad of country towns? Many expert colonizers look with distrust on these elements, believing that they will not take kindly to the labor of rural life, but will expect to sit in the shade of their vines and fig trees while the salubrious climate of the new West lays in their laps a living as a voluntary offering. Those who hold this view maintain that successful colonists can be drawn only from the farms of the East and middle West. With this notion THE IRRIGATION AGE has nothing in common. It is true that it has sometimes happened that persons unskilled in farming have become easily discouraged, while those with an agricultural training have succeeded all about them, but we lay it down as a prophesy that the most successful settlers upon irrigated lands, as a class, will be men from the cities and towns. This has not always been the case because promoters have too often been content to turn their settlers upon irrigated lands without any attempt at advising or instructing them in a phase of the agricultural industry new even to skilled farmers. But that day is rapidly passing. Irrigation as a science is coming to be understood and appreciated, and the more progressive companies are going to great lengths to assist their settlers in planning their operations wisely and executing them skillfully. Competition will soon render it impossible for a narrow-minded company to make headway against those who invest money and brains in mapping out attractive colonies and showing their settlers the path to enduring prosperity. Now, there are those who will and those who will not be taught. It is the men from the cities and towns who will be found plastic material, ready for moulding at the hands of experienced and educated farm superintendents. They will real-

ize their need of instruction, will take kindly to it and will enter intelligently upon a kind of farming that offers wide scope for intelligence. The labor of country life in a region of small farms, framed by noble and various scenery, will be found very different from the drudgery of country life on the dreary stretches of eastern plains.

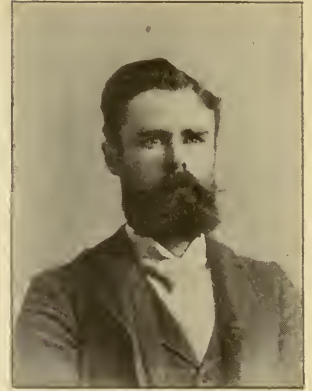
**Cheap
Fares a
Factor.**

Not the least factor in the present vigorous movement of colonization is the reduction in through fares from Chicago to California. Rates like the present would stimulate emigration to the Golden State at any time, but they are especially effective at a time when the desire to find a place where a small investment will earn a living for its owner is so nearly universal. Fortunately California is ready for the invasion. There are thousands of acres under completed works awaiting the settler's coming, and these lands cover a wide range in prices. Land can be had in several localities for the government prices, in others for \$40 to \$75 per acre, and from that all the way up to \$400, the latter where the "bay and climate" are particularly seductive. The future of California appears very secure. The glittering fame of the State seems never to cease growing. The bread cast upon the waters at the World's Fair is bearing fruit thus early. And yet California has serious problems to confront in connection with her enormous agricultural and horticultural expansion. It cannot be denied that her wheat farmers and fruit growers are doing business to-day on a slender margin of profit. At least, their prosperity is not sufficiently marked to tempt new men into the field unless they have faith in an early change for the better. And yet there is one great truth that cannot be gainsaid—there is not a piece of tillable ground twenty acres large anywhere in California that will not support a family in luxury, *provided* that family is content to produce what it consumes first of all, and its speculative crop afterwards. The man who goes to California with that idea under his hat will encounter no disappointment. He will live in the most genial climate, amid the most charming scenery, and his prosperity will be just as certain as if he had bought \$30,000 of Secretary Carlisle's new bonds at 117.

**Prospects
in other
States.**

Will California be the only State benefited by the present currents of colonization? No; but it has three important advantages: (1) It is far and away the best advertised State in the Union; (2) it has the largest area and the largest variety of land ready for colonists; (3) it has the chief benefit of the low fares. These advantages are of sufficient importance to guarantee to California the lion's share of the new immigration

of the present spring. And yet other States and Territories must be benefited, in a degree, immediately, and, in the long run, very largely. Idaho, Washington and Colorado are enjoying a very fair growth to-day, and are certain to gain more recruits as time goes on. These States have large areas under fine systems of canals. New Mexico is also in a position to get considerable benefit from the new growth in the West. It is next year, and for the next ten years, that the arid West as a whole will receive its substantial benefits, however. All localities will learn from the events now occurring that the time has come at last when money and men can be attracted to irrigated lands. And energies will be directed to this line of development in earnest. The tide which will cover the West with prosperous homes will be started in this direction, and, once started, it will continue without serious interruption for years to come.



M. A. DOWNING,
Of Las Cruces, New Mexico.

**New
Mexico's
Attractive
Book.**

One of the most attractive books issued in the interest of the new West in a long time is the new work just from the press of the *New Mexican*, of Santa Fé. It is entitled "New Mexico," and is published by the Bureau of Immigration of that promising Territory and coming State. The veteran editor, Max Frost, is credited on the title page with the authorship of the book, but in a prefatory note he gives the credit for an important part of it to Mr. Mortimer A. Downing, and it is no secret that the latter gentleman performed the major portion of the hard work involved in the preparation of the book. Mr. Downing is one of the bright young men of Arid America, and a person who may be counted upon as certain to be heard from hereafter. He served for several years in the Bureau of Irrigation Inquiry at Washington, D. C., and upon severing his connection with that department took up his residence in New Mexico. Few men in the United States have studied the irrigation problem more thoroughly or practically. The New Mexico book has been prepared with fine literary skill and careful regard for the requirements of settlers and investors. The illustrations are profuse and attractive. The resources, industries and climate of the Territory are covered in their general aspects.

OWNERSHIP OF LANDS IN THE ARID REGION.

By J. W. POWELL, DIRECTOR OF THE U. S. GEOLOGICAL SURVEY.

[This is the second article in the series written as the outgrowth of the discussion aroused by Major Powell's celebrated speech at Los Angeles last October. In due time those who disagree with the statements put forth in these articles will have full opportunity to reply. It is just as important to have presented one side of the debate as the other, but it is desirable to have one side clearly understood before the other is presented in the form of an answer. For this reason Major Powell's arguments will be carried to a conclusion before the replies are published. THE IRRIGATION AGE acknowledges the receipt of many letters and several articles of length which take exceptions to statements contained in the February paper, "The Water Supplies of the Arid Regions." It is also aware that the letter of explanation from the author, appearing in March, is rejected by many as unsatisfactory. Fair play will be awarded to everybody. THE AGE reserves its own conclusions until all the evidence is in. What settlers and investors want to know is *the truth* about the water supply and the arid lands owned privately and publicly. THE AGE believes they will learn the truth, fully and exactly, when the discussion in its pages is concluded.—THE EDITOR.]

THE United States, exclusive of Alaska, has a land area of nearly three million square miles. A part of this land never belonged to the General Government. The original States, the colonies and the mother countries disposed of their lands to individuals, and the same was true in Texas. But on the organization of the Federal Government large tracts of unoccupied land fell into its possession. From time to time other lands were acquired by treaty, until a vast estate was included in the public domain, stretching from the boundaries of the original States to the Pacific sea. Gradually these vast possessions have been disposed of, at nominal prices or by gift, until the acreage remaining in the hands of the Government has been reduced to 632,000,000 acres, which is very nearly one-third of the total land area of the United States, Alaska being neglected.

The first diagram exhibits the proportions between the area of the United States (exclusive of Alaska), the area of the nineteen older States, the area of Texas, the area of homestead and miscellaneous entries east and west, the area of land grants and railroad selections west, the area of Indian reservations, the area of forest reservations, the area of vacant lands east, and the area of vacant lands west.

The second diagram exhibits the proportions between the vacant public land, land in private ownership and farm area for 1890, in those States where there are arid and sub-humid lands and where irrigation is practiced. The cross-lined portions of the central section of the diagram, pertaining to land in private ownership, exhibit the areas granted or selected by railways.

LOCATION OF VACANT LANDS.

Of the vacant lands, 19,000,000 acres are situated in the eastern half of the United States, chiefly in Minnesota, Arkansas, Louisiana, Mississippi and Florida, where the climate is humid and agriculture possible without irrigation. Again, there are 43,000,000 acres

of land mainly covered with heavy timber, in California, Oregon and Washington, and to a small extent in other arid States where the climate is humid, and, in some places, excessively humid. This leaves in the hands of the Government 570,000,000 acres of public lands in the arid and sub-humid regions, where agriculture is mainly dependent upon irrigation.

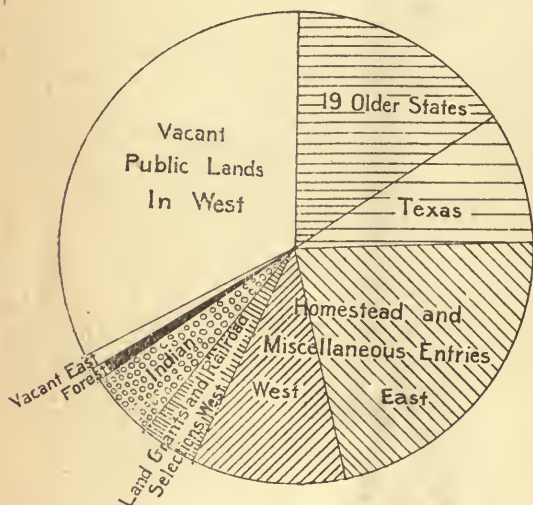
Considering the distribution by States of the vacant public lands that are arid and sub-humid, the following table is given, the figures being in round numbers:

States.	Acres.
Arizona,	55,400,000
California,	41,000,000
Colorado,	44,000,000
Dakotas (both),	27,000,000
Idaho,	47,000,600
Kansas,	700,000
Montana,	74,600,000
Nebraska,	10,000,000
Nevada,	67,200,000
New Mexico,	54,900,000
Oklahoma,	10,000,000
Oregon,	30,000,000
Utah,	42,600,000
Washington,	11,700,000
Wyoming,	53,300,000
	<hr/> 570,000,000

In addition to the public lands proper, that is, the lands owned by the United States, many of the States themselves own lands, which are not here considered.

Of the 570,000,000 acres of public lands in the arid and sub-humid regions, certain portions are already dedicated, permanently or temporarily, to specific purposes. Large grants of land have been made to the railroads. The titles to a part of these lands have already passed out of the hands of the general government, but there are other large areas where

the titles are yet inchoate, and still other lands where the titles are in dispute. Under these circumstances, it is impossible to state in definite figures the amount of the lands which will thus ultimately pass out of the hands of the Government. Again, there are large tracts of land in the arid and sub-humid regions still belonging to the General Government but which are included in Indian reservations. The total area of these lands is 63,000,000 acres. And yet again, there are large tracts of Government land included in the forest reservations. In part these forest reservations are in humid regions, but they encroach upon the arid regions and have a considerable extent therein, but are elevated and mountainous, and constitute the most important catchment area for the water supply of the arid region. The total amount of these forest



Exhibiting total area of United States, exclusive of Alaska, and showing proportions of vacant, reserved and disposed of lands.

reserves, including the Yellowstone National Park, is nearly 20,000,000 acres, of which a part—but not a clearly defined part—falls within the arid region.

There is therefore left within the arid region an area of a little more than 500,000,000 of acres yet open to settlement—not disposed of to individuals, not in the possession of corporations, not included in Indian reservations, and not included in timber reservations.

These estimates of the extent of vacant public lands have been prepared from reports of the general land office, and have been revised by a critical examination of the original records of that bureau.

HOW MUCH CAN BE UTILIZED ?

Considering only the 500,000,000 acres of vacant and not dedicated lands which lie wholly within arid or sub-humid climates, it is of primary importance to

determine what proportion of these can be utilized by the present or coming generations, employing the resources known to exist or the methods proved to be feasible. In order to make an analysis of the value and resources of this vacant public land, a general map (shown on page 145) has been prepared, exhibiting its location. As shown by this map, in central North Dakota, central South Dakota, western Nebraska, western Kansas and Oklahoma, lands are found in scattered spots. Westward the areas increase in size and gradually join in larger blocks, until in Montana, Wyoming, Colorado, New Mexico, and the States and Territories to the west, the vacant lands form by far the greater part of the area, the private lands appearing as scattered islands. Toward the Pacific coast and northerly in the plains of Washington the vacant lands decrease again, broad stretches of private lands occupying the great valleys of California and the States to the north.

Crossing the vacant public lands are the broad belts of lands granted to various Pacific railroads. Within these bands, from 50 to more than 100 miles in width, every alternate section is claimed by some corporation. Although selections of millions of acres have been made by the railroads, not all of these selections have been patented. The total area rightfully owned or claimed cannot, therefore, be ascertained until many pending decisions have been rendered.

RESERVATION LOCATIONS.

Besides the railroad lands, there are two classes of lands belonging to the Government which should be considered, namely, the forest reservations and the Indian reservations. The forest reservations are of late origin, being created under the act of March 3, 1891. There are now eighteen of these, having a total area, including the Yellowstone National Park, of 19,483,800 acres, or very nearly one per cent. of the total area of the United States. The greater portion of these reservations are in Oregon and California, along the crests of the Cascade mountains and the Sierra Nevada, and in Colorado, where they cover parts of the higher mountain ranges.

The Indian reservations of the West have been greatly reduced within the past decade, and now comprise only 63,162,283 acres of the West, being 7.2 per cent. of the arid and sub-humid regions, and 3.2 per cent. of the whole United States. The total area of all Indian reservations, east and west, including Indian Territory, is 4.7 per cent of the whole United States.

PRIVATE LAND IN THE STATE.

Deducting the vacant public lands and the reservations as given above, there remain the private lands in each State. These fall into two classes: First, grant lands, including railroad selections, and the



Western half of United States, showing the relative location and area of Vacant Public Lands, Indian Reservations, Railway Grants, Forest Reservations and lands in Private Ownership.

private land grants, mainly within California and New Mexico, originating from the former Mexican rule; second, claims or sales based upon the homestead, desert, preëmption, and other laws. These are as follows:

State.	Lands, Grants and Railroad Selections.	Miscellaneous Disposals.
Arizona, . . .	2,424,919	1,447,060
California, . . .	12,500,000	21,500,000
Colorado, . . .	1,964,000	15,440,000
Dakotas (both), . . .	7,089,281	45,000,000
Idaho, . . .	402,000	3,662,000
Kansas, . . .	19,287,000	32,197,569
Montana, . . .	5,297,000	3,720,000
Nebraska, . . .	3,066,000	35,000,000
Nevada, . . .	190,000	2,000,000
New Mexico, . . .	16,530,764	2,300,000
Oklahoma, . . .		6,825,722
Oregon, . . .	1,140,000	9,860,000
Utah, . . .	700,000	5,335,000
Washington, . . .	7,631,000	10,369,000
Wyoming, . . .	769,000	3,384,000
	78,990,964	198,040,351

The following table gives the area of lands in each State partly out of the hands of the government, or

Dakotas (both), . . .	14,184,741	
Idaho, . . .	2,234,011	
Kansas, . . .	89,871	
Montana, . . .	9,382,400	
Nebraska, . . .	126,503	
Nevada, . . .	808,215	
New Mexico, . . .	4,300,000	311,040
Oklahoma, . . .	7,605,478	
Oregon, . . .	1,929,105	4,653,440
Utah, . . .	3,972,480	
Washington, . . .	4,045,284	967,680
Wyoming, . . .	1,810,600	3,159,040
	63,162,283	19,484,800

On examining the map of vacant public lands, it is apparent that selections of entered lands in the arid and sub-humid regions have been governed by the water supply—in other words, the lands have been taken around springs and along streams. In fact, within the past ten years nearly all of the land to which water can be easily conducted by canal has been filed upon.

A classification of the lands, based on the assumption that an artificial supply of water cannot be had for most of this area, has been attempted, in order to arrive at their value for other purposes besides culti-

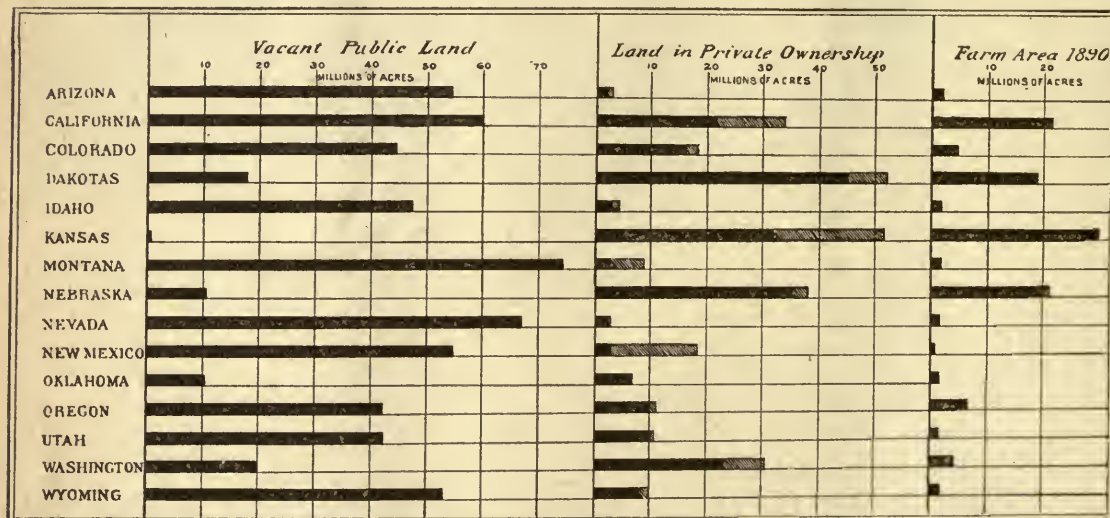


Diagram illustrating the relative area of Vacant Public Land, the Land in Private Ownership, and the Farm Area in each of the Western States and Territories.

at least for the time being dedicated to special purposes:

State.	Indian Reservations.	Forest Reserves.
Arizona, . . .	11,116,000	1,851,520
California, . . .	463,795	5,438,720
Colorado, . . .	1,094,400	3,103,360

vation. A careful estimate gives the following results:

	Acres.	Per cent.
Desert lands, . . .	60,000,000	10.5
Grazing lands, . . .	420,000,000	73.7
Timber lands, . . .	90,000,000	15.8
	570,000,000	



WESTERN HALF OF UNITED STATES, EXHIBITING REGIONS WHERE DRY FARMING IS CARRIED ON.

Besides these uses, many of these lands are of inestimable value for mining purposes. These divisions are, of course, only approximations, but they serve to exhibit the proportional values of these great tracts. Nearly three-fourths of the vacant public lands, or 22 per cent. of the whole United States, is adapted to and is now quite fully utilized as a great free range for cattle, and will continue to be so utilized until disposed of by Congress or until the native grasses and shrubs are destroyed by over-stocking the ranges. Of that classified as wooded, a part is valuable for lumber, but the greater portion supports a scanty growth of trees, suitable only for fire-wood and fencing. Among the trees good grazing is usually found, so that much of the wood land could also be included under the head of grazing land.

WATER SUPPLY IN RELATION TO ARID AND SUB-HUMID LANDS.

Any consideration of the quantity of vacant land which can be utilized for other purposes than grazing, wood land and mineral wealth must rest upon

from creeks to large rivers, have been gauged, and a record kept of their fluctuations from day to day for periods of from one to five years, while a few measurements have been made of a large number of other streams. The results obtained have been shown graphically upon the run-off map published in the February number of *THE AGE*, and from this certain approximations have been obtained concerning the total water supply of each of the States and Territories. In order to do this it is obvious that a number of assumptions must be made, both as regards the actual quantity of water discharged and the possibility of utilizing this, and in such assumptions it is doubtful whether any two men would arrive at identical conclusions. This fact, however, need not prevent us from making the comparisons of water supply with land areas, for even if the results obtained by other persons differ somewhat, the general conclusion must be nearly the same, namely, that the water supply is small as compared with the area of land.

In order clearly to bring this out, the following table has been prepared, showing for each of the



SHOWING THE TOTAL AREA OF ARID AND SUB-HUMID LANDS, THOSE IN PRIVATE OWNERSHIP AND THE AVAILABLE WATER SUPPLY FOR THE SAME.

a consideration of the water supply of the area. Estimates as to the possible water supply are based upon accurate measurements of streams in different parts of the arid region. It is obviously impracticable, except by enormous expenditures, to ascertain the quantities of water flowing in all the streams, and therefore, in order to obtain definite data, such streams have been measured as would give the best results, not only for local use but for general conclusions. From thirty to fifty streams, ranging in size

States and Territories the total area of arid and sub-humid lands, the area of arid and sub-humid lands in private ownership, and the area of available water supply:

In estimating the water supply by States and Territories, two important assumptions have been made. First, it has been assumed that the upper tributaries of the Colorado river will ultimately be utilized in such a manner as to take out all their water upon the lands by the construction of canals and reservoirs,

	ARID AND SUB-HUMID LAND.		Available Water Supply.
	Total In State.	Private Ownership.	
Arizona	72,000,000	3,800,000	3,000,000
California	76,800,000	28,000,000	17,000,000
Colorado	65,000,000	17,400,000	8,000,000
Dakota	50,000,000	9,000,000	1,500,000
Idaho	50,000,000	4,000,000	7,000,000
Kansas	15,000,000	14,300,000	1,000,000
Montana	90,000,000	9,000,000	11,000,000
Nebraska	23,000,000	13,000,000	1,500,000
Nevada	70,000,000	2,200,000	2,000,000
New Mexico	78,000,000	18,800,000	4,000,000
Oregon	40,000,000	10,000,000	3,000,000
Utah	52,000,000	6,000,000	4,000,000
Washington	20,000,000	9,300,000	3,000,000
Wyoming	62,000,000	4,000,000	9,000,000
	763,800,000	148,900,000	75,000,000

and that the water which can be taken from the lower Colorado in Arizona and California will be that which is caught in the deep cañons and cannot be taken out upon the upper lands, and that this supply will be equally divided between Arizona and California. Second, it has been assumed that the water of the upper Columbia will be divided between British and American territory in proportion to the area of catchment falling within the two countries.

In a former article the conclusion was reached that if all of the water supply of the arid and sub-humid regions could be used, it would be possible to irrigate 75,000,000 acres of land; but it was further stated that it would probably not be practicable, for reasons therein given. But in the above table and in the diagram it has been assumed that the whole of the water will be utilized. The fact is that the extent to which the supply will be utilized will depend very largely upon local conditions, especially the character of the crops and proximity to the great markets.

We have spoken of humid, sub-humid and arid lands. The sub-humid lands are intermediate in climatic conditions between the humid and the arid, and really constitute their connecting link. It is not possible to draw accurate lines between these limits. While irrigation is practiced on arid lands and sub-humid lands, yet the sub-humid lands, falling between the two extremes, are actually cultivated in part by irrigation and in part by dry farming, as it is usually termed in the West.

DRY FARMING IS PRECARIOUS.

The preceding map shows the relations between the arid and humid regions by exhibiting the regions where dry farming is carried on and how they merge into the humid regions. The area of dry farming in the sub-humid regions is extensive, nearly equal to that carried on by irrigation in the sub-humid and arid regions. The extent of this dry farming will ultimately be greatly increased, so that the agricul-

tural resources of the sub-humid lands will be much enlarged, and the great, dry West will depend in part on irrigation and in part on dry farming. But in general it may be stated that dry farming within the arid and sub-humid regions is precarious, and that it ought not to be depended upon exclusively, but only as an adjunct to farming by irrigation and to stock farming.

From the above tables it will be seen that, taking the arid and sub-humid regions at large, the area of lands in private ownership exceeds the water supply, but that generally throughout the arid region there are lands in private ownership which cannot be irrigated. Often tracts of land have been taken up with the expectation of irrigating but small portions thereof; and only small portions of the Spanish grants can be irrigated. Thus it is that there are lands widely scattered throughout the arid region in private ownership which cannot be irrigated, and, on the other hand, there are in the aggregate several million acres of land in government ownership which can be advantageously irrigated. But there are very many valleys in which the lands in private ownership which can be irrigated exceed the water supply. Often in this case the water is not used because the irrigating works have not yet been sufficiently developed therefor. Whether in such cases the water supply should be held for the use of the owners of the lands or whether the yet uncontrolled waters should be diverted to lands now in the hands of the government, is a problem worthy of consideration by the people who have acquired lands and by the people of the United States at large.

A LONG SIPHON.

According to *Indian Engineering*, a long siphon has lately been added to the water supply system of the Nusseerabad cantonment in India. The water is drawn from a well in the overflow channel of a lake; a weir below the well preventing any serious fluctuations in the water level in the latter. Until recently, the water has been pumped by bullocks from the well into a main leading to the cantonment. Toward the end of August this method of supply was discontinued and a siphon service put in. It is an eight-inch pipe, about four miles long; lowest depression is about thirty feet.

A large irrigation enterprise is about to be undertaken in Mexico. A contract has been signed with Engineer Scougall for works consisting of a dam six miles above the junction of the San Juan and Rio Grande rivers, and some 100 miles of canal and laterals, which will, when completed, permit of the irrigation of 500,000 acres of good cotton land.

IDEAL IRRIGATION METHODS IN NEW MEXICO.

BY A. E. BLOUNT.

[The following paper, on irrigation methods in New Mexico, is published this month instead of Mr. Van Dyke's usual article. Mr. Blount will be followed by other managers of experimental farms in the arid region. Mr. Van Dyke's fourth and fifth articles will be published together in May. The very carefully studied papers on advanced methods, which THE AGE is presenting this year, will certainly become classics in their line.—THE EDITOR.]

FROM time immemorial, from Trinidad on the north to El Paso on the south, and even down in old Mexico, the system of irrigation has not been and is not what it should be, because the manner of applying the water not only takes the life out of the soil, but often scorches tender plants, and even scalds fruit trees on the south side so severely as to kill and otherwise render them worthless.

THE PRESENT POOR METHODS.

For small grain and corn, the system consists in letting the water from the canal into small beds around which are high borders, and in these it stands until it sinks away or evaporates, altogether too long a time for the good of any plant. All gardens and fields are thus bordered up at great expense not only for labor in making them every year, but in the loss sustained from drowning out the seed and injuring the crops. The method of cultivation consists in first plowing the ground three or four inches deep, at the same time covering the seed at all depths, and then cutting it up with borders and beds for the water.

EFFECTS OF THE METHODS.

The effects of so much water so bountifully and unseasonably applied are plainly seen in the sickly growth of the plants that follows and the poor stand on the ground. Garden vegetables are planted on ridges and irrigated without fear or favor and without any consideration of the water supply or the demands of the plants. Entirely too much water is used injudiciously and wastefully on all crops. With a third of it the crops would be far better and much more prolific.

The trees of the orchard are put in a ditch with high borders on each side and then the ditch is filled with water, the trees at the same time standing a foot deep in it, and when the hot sun strikes the bark of a young tree in particular, it becomes black and often dies on the south side, thereby making the fruit small and worthless.

THE VITAL POINTS TO SETTLE.

Irrigation is a problem that cannot be solved mechanically. The mere putting on of the water is no part of the solution. When, how and why, are the questions that, if answered correctly, will give the true solution. It is not the art, but the science that settles the matter.

All plants need moisture—some more, some less—and they demand it at certain seasons and in certain ways. In this arid climate rain, when it comes in showers, is often detrimental to some crops, because it comes when the crops are in a condition that they will not endure the presence of moisture, not having had opportunities of previous protection against the effects of the combined influences of sunshine and rain, one following the other. For instance, when it rains on wheat at noon and the sun comes out with all his intensity, the crop is seared, and if not too young the grain shrivels in the ripening. Potatoes rust from the same cause. The blades of corn curl up and die. Oats and barley wither and often stop growing then and there.

WHEN TO APPLY WATER.

No crop but tells us when it wants water. The grasses, clovers and small grain have a language that cannot be mistaken. Whenever their green color becomes very dark and sickly, put on the water. When corn wants water, it tells the fact by its leaves being curled up in the morning. Salsify needs but little, if any, water after it is well under way. Carrots cannot bear an irrigation by flooding after they are half grown. If covered with water the crowns decay. All species of the cabbage family require a good deal of water. In other words, they like wet feet, and are very particular how it is applied. Most plants, yes, all plants in this arid climate should be pushed in their early stages of growth by a judicious application of the proper amount of water and frequent cultivations, at no time letting them stand or go back from want of water and proper attention.

Plants in general need much less water than is usually applied by almost everyone. They do far better and suffer much less with two inches on the surface applied two or three times during their growth, than they do with twelve inches on the surface applied five or six times in a season. It is a sad mistake to put on so much water.

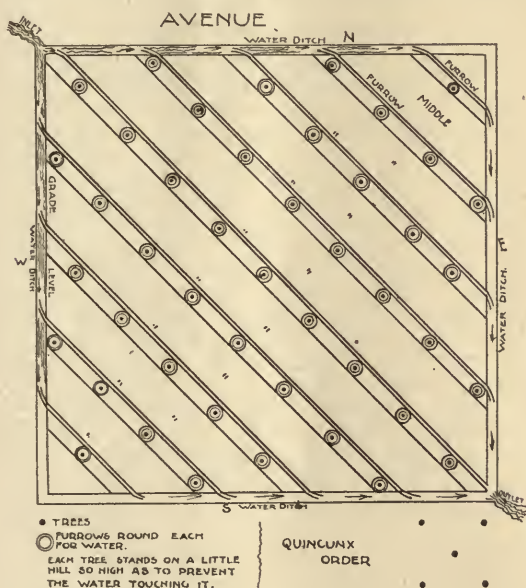
HOW TO PUT ON THE WATER.

In field culture all small grain, the grasses, and all sowed crops must be irrigated by flooding. The water should be put on as rapidly as possible, with no let-up—the quicker the better. It should not be allowed to stand in pools anywhere, because standing

water stops all the pores in the soil, cutting off the air from the roots and, as it were, taking the life out of them for a time. Aquatic plants excepted, no plants can live without air, and that air must envelop the roots as well as the plant itself to give them vitality. Corn, vegetables and all hoed crops should be irrigated by the furrow system, if it is not possible to use underground irrigation. By this system the water is conducted in furrows between the rows, so deep that it is made to come *up* to the roots in the soil and never so high as to touch the stalks, as it, together with the hot sun, often kills tender plants and also makes a crust on the surface that has a tendency to shut off the air from the roots.

WHY IT IS NECESSARY TO IRRIGATE.

In this dry climate rain is very good for crops when it comes at the right time and in proper quantities, and, furthermore, it is applied in the most scientific



method, but that happens only once in a hundred times; hence irrigation is altogether better at all times, because the water can be applied when the crops need it and be kept off when they do not need it. The quantity also can be regulated as the crops demand. As the roots are the main avenues through which the plant gets its food and the water the main agent to carry that food to and into the plant, the reasons why we irrigate are very evident. Irrigation is carried on to promote the growth of plant life in making soluble all plant food in the soil and in reducing it to a condition capable of being taken up by the roots. It is reduced by chemical action to an infinitely attenuated condition and goes into the roots in a very fine hygroscopic form, all through the

agency of water. When the water is put on crops in too great quantities and permitted to stand too long around them, the pores of the soil become choked up and the roots refuse to act and death to the plants is the result.

We come now to the consideration of the request of the editor of *THE AGE* for a "description of the methods used in this station and the results obtained." The method used by us in the orchards is unique and is not practiced by anyone elsewhere to our knowledge. It is peculiarly well adapted to our climate and soil, and I might say to all sections of the arid regions. The results are highly gratifying, and I think are much better than any I have ever tested.

UNIQUE METHOD USED IN ORCHARDS.

In the first place for an orchard, the land is well plowed, pulverized and graded on an incline of one inch to the hundred feet east and west and on a level north and south. Deep furrows are then run off at an angle of 45 degrees to the avenue and with two heavy teams and a subsoiler its point is put 18 inches deeper into the subsoil leaving in clay and heavy soils a drain that will carry off all surface water and retain moisture for the roots quite a long time.

In these rows holes are dug so as to have the trees stand in the quincunx or hexagonal order as seen on the plats enclosed. This method of planting fruit trees is the most satisfactory way, because the land can be cultivated anyway, the weeds can be much more easily subdued, and the roots will receive the water much more uniformly.

When the water is let in to irrigate the trees, it comes through a box from the main ditch at the northwest corner and made to run east and south, a part flowing into each furrow along its line, entirely encircling the trees in it and then on to the next, until all the furrows are filled and the trees well irrigated. This constitutes the duty of water on this orchard and in no case is the water allowed to run over into the middles to encourage the growth of noxious weeds. As the trees grow larger the circular furrows round them are necessarily made larger, not only for convenience but the water reaches the roots in better shape.

CULTIVATING THE TREES.

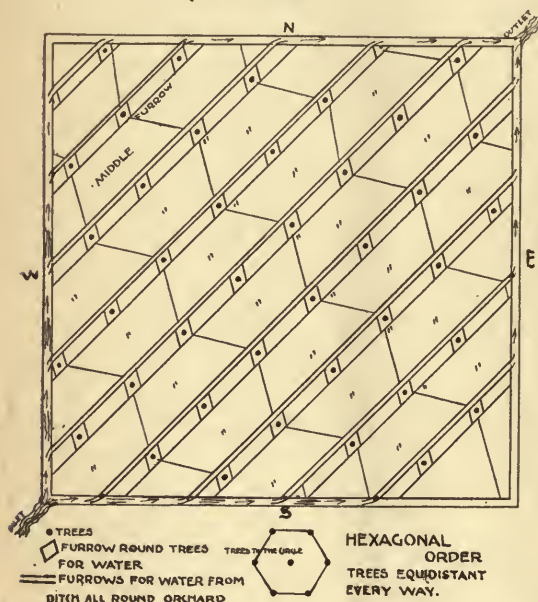
So far as cultivation is concerned, I might state that the orchard is plowed twice a year, once in the fall 8 inches deep and then again in the spring at the same depth, but across the other way, and during the summer the middles are cultivated all the time for the purpose of absorbing the atmospheric moisture and keeping the soil in good tilth. By actual experiment I find that three or four cultivations crosswise and shallow are equivalent in effect to an irrigation so far as moisture is concerned; in fact, they keep the soil in a moist condition when executed at the right times.

Before water is let into the furrows around the trees, their trunks are hilled up to prevent it from striking the bark, as in this climate it and the hot sun together in contact with the bark at the same time, produces the sun-scaled—the real cause of so many trees dying on the south side in this section and also in many other localities.

PRUNING.

In pruning, the trees are all headed back low with their limbs as near the ground as possible, so that

AVENUE



their own foliage will be a protection to the trunks from the sun, and then too the fruit is more easily picked off.

VEGETABLES AND CROPS.

The system of irrigating vegetables and crops for experimental purposes, and all hoed crops in fact, consists in running the water in shallow furrows between the rows of whatever is being raised, the land beforehand being graded on a gentle incline. This method brings the water *up* to the roots, preventing it from touching the plants and from forming a crust on the surface and around the base. Except the cabbage family, about three irrigations during the season are enough to mature almost any crop. For the grasses, clovers, and all sowed crops, we have to resort to the system of flooding. With "a big head of water" it is pushed on and over the crops as rapidly as possible to prevent it from standing, and so soon as the land is covered, the water is taken off. On upland alfalfa is irrigated a week or ten days before cutting and on some land twice between the

cuttings, making the water stand about two inches deep on an average all over the surface. Some farmers put on ten inches on the surface at an irrigation, which is altogether too much, as has been proven time and again as shown by the results.

I might, in conclusion, say that the water of the Rio Grande is very muddy at all times. The sediment is so rich that thus far I have had no cause of resorting to any fertilizers of any kind to insure a full crop, except for experiment. I find that it puts on more fertility than any one crop can take out of the soil in a single season. The sediment contains much vegetable matter and is full of all the elements of fertility, except, perhaps, phosphoric acid.

THE SAN JUAN ENTERPRISE.

A correspondent in writing of the San Juan irrigation enterprise in old Mexico says: "The necessary works on this undertaking consist of a very fine masonry dam with accessories, which will be built some fifteen miles above the mouth of the San Juan river, which river rises in the mountains near Monterey, Montemorelos and Linares, and falls into the Rio Grande nearly opposite Fort Ringold or Rio Grande City. From this point the canal will run in an easterly direction, following the foot-hills, and will water all the land (some 30 sitios) lying between it and the Rio Grande. Its total length will be 90 kilometers, which will reach beyond the city of Reynosa, situated on the Matamoros division of the National railroad. This length can be extended if necessary. What engineering difficulties have arisen are all encountered on the first 7-8 kilometers from the head gates of the canal. A 1,500 foot tunnel and a kilometer of open cut, some 25 feet at its deepest part, together with 5,000 feet of fluming along the steep bank of the river San Juan, are the chief works, in addition to the main dam and head works. The balance of the undertaking is all plain sailing. The canal will start out with a bottom width of 25 feet and a depth of water of 7 feet decreasing in size as the canal runs easterly and distribution goes on. Provision has been made for 40-50 kilometers of lateral or distributing canals, with regulating gates, to divert and measure out water from the main canal. Ninety kilometers of telephone wire and five instruments will form part of the undertaking. Irrigation is bound to play a prominent part in the future of this country.

The faculty of the University of Wyoming has commenced supplementing the work of the railroads by publishing a series of pamphlets on the irrigation question, with a view of inducing immigration to that state. Prof. Johnson of the faculty has gone east on a lecturing tour, with the design of interesting capitalists in Wyoming.

THE SOCIAL, ECONOMIC AND FINANCIAL PHASES OF IRRIGATION.

BY C. A. GREGORY.

WE shall get some light on the subject of irrigation if we give its definition in such terms as shall show its extension in use, and its limitations and boundaries as a practical art.

It is not the putting of water on land merely; if it were, it would include hydraulic mining; it would include also the putting of water on land to kill vegetation, as where noxious vegetation abounds, or alkali abounds, and you wish to kill it by drowning it out. It is, therefore, something different from this.

If I make a definition of this subject, as I think we use the term, it is: The artificial application of water to land, by skillful, systematic and scientific methods, for the purpose of promoting agriculture and horticulture. And such a definition implies that it is an art in which proficiency must be acquired, and that behind the art lies the science of engineering and organic and inorganic chemistry and a knowledge of plant life, and that it is essentially a manufacturing of crops of the field, farm, orchard and garden.

Water is not only necessary for vegetable growth, but it is well established that to a great extent the amount of growth depends upon the quantity of water supplied to the crop. I cannot stop to dwell on this topic, but it may be stated as a law that the measure of the water consumed may be considered as the measure of the capacity of the soil to furnish its product. I say the measure of the water consumed by the plants—not the measure of the water poured on—a different thing. You may put too much water on the soil and work an injury by such excess. Few persons realize the value of water to plant growth. In plant society, commerce is carried on by water and life is sustained by water. Water is the common carrier of plant food; inter-communication between the elementary substances, gases, soils and air is carried on by the agency of water. Let this suffice here to show its necessity and importance.

GREAT IS IRRIGATION.

The most important, practical, scientific and social industry of our time and country is irrigation.

In humid America the extent of its usefulness is not much thought about. It is only lately that the irrigation problem has awakened interest, and I regard it as an evidence of the aroused interest in this subject that conventions are being held in various states, inviting a discussion of this subject. Such a thing was not possible a few years ago. It shows that the irrigation idea has at last penetrated the public mind, that it has fastened itself on the mind as a matter of importance, as a matter worthy of consid-

eration on the part of those who largely direct public affairs, as well as those who place dependence on the art for their support.

The farmers in the humid region would do wisely to consider the aggregate gain to capital that could be made by great attention to irrigation. Our climate is changeable, sometimes too much rain, sometimes too little rain, and rain at a time when it is of little use to the farm and orchard. It is not suggested that great canals and irrigation works should be established in this region, but it is insisted that drouth loss can be minimized by use of water that lies near at hand and now goes to waste. It lies on the surface in ponds and lakes, or runs in perennial streams, or in the earth near enough to the surface to be often availed of by some method of lift irrigation. Our long summer drouths occasion great losses. Farmers may largely avoid these losses by even that partial and inexpensive irrigation which very many localities make practicable. The meadows, the gardens and orchards may profitably be irrigated in the humid region. I mean the expense of providing irrigation for such special uses will generally be justified by the large increase of the amount of crops, as well as by the evading of drouth losses. Five acres, or ten, well cultivated and supplied with abundant water, will yield, in the course of ten years, as much profit as fifty or a hundred acres equally well cultivated, but without any provision for the necessary moisture.

AN EASTERN EXPERIENCE.

I know of a man in Niagara county, New York, who makes his living out of a garden. He cultivates an acre and a quarter of land in blackberries. His losses by drouth were large in the aggregate, so he thought of irrigation, and, mindful of a pond near his piece of land, he put an iron pipe from the pond to his land and carried the water to his garden. The first year he used it he took off \$600 worth of blackberries as his crop, while his neighbors engaged in the same work, by reason of the drouth that season, got nothing. Instances could be multiplied. Indiana is reputed as a wet state. Losses by drouth are large there. An Indiana farmer, having gone to the arid region to live, told a friend of mine that he had lived on his farm in Indiana many years, and for twenty years he had kept a diary of the weather and of crop yield, and the aggregate of drouth losses was surprisingly large; that he had learned a lesson in the arid region, and he was going back to Indiana to do a thing there that would indeed make his neighbors think he was a "crank"—he was going to irrigate his farm!

Irrigation is known to be the dependence of the Arid West of America for agriculture. The extent to which irrigation can be practiced is enormous. The total area irrigated in India is 30,000,000 acres; in Italy, 3,700,000 acres; in Egypt, about 6,000,000 acres. In Spain there are 500,000 acres, in France 400,000 acres, and in the United States some 8,000,000 of acres.

I speak of lands irrigated and cultivated to crops, and not merely of lands "under ditch," as it is called when lands are provided with the means of irrigation whether cultivated or not. This means that some more than 48,000,000 acres are cultivated to crops which but for irrigation would be barren and unproductive in the countries I have named. In addition to this, there are some millions more of acres cultivated by aid of irrigation in China, Japan, Australia, Algeria, South America and elsewhere.

THE AREA OF RECLAMATION.

The field for its greatest extension is in the arid region of the United States; this is what makes it most interesting to us. Major Powell puts it that some 40,000,000 of acres can be irrigated in our arid region; that such land will be found to be wonderfully productive, and that their products will support a population as great as that found in the United States at the present time. The area of our arid region is stated to be 883,312,000 acres, but that only a small percentage of this can be irrigated, and only about one per cent. of this area is as yet cultivated. Some students of this question set the area of possible reclamation as high as 100,000,000 and 200,000,000 acres. We need not discuss this part of the question, as the argument lies in my mind it is not important to set the limit to reclamation, though highly interesting as a scientific inquiry. The feature I present is that the lowest estimate makes it a matter of national importance and makes the region of most value reckoned in money values.

Say the average value of land is \$83 per acre, 40,000,000 acres makes \$3,320,000,000. Later on I will show why I assume the price of \$83 per acre. Put the value of farm land at \$30 per acre, and you have \$1,200,000,000 in value. In the compendium of the census of 1890, that is to say in the census bulletin, it is stated that the estimated value of land with water rights united thereto, is \$83 (and plus) per acre. That is, the average value of the irrigated land in the arid region is \$83 per acre, and its annual average yield is over \$14 per acre, nearly \$15, or a return of between 17 and 18 per cent. per annum on \$83 per acre.

IT IS ABSOLUTE SECURITY.

Under irrigation, agriculture is made a secure and safe investment for profit. Contrast, if you please, the security of the farmer in the arid region, working his land under a good irrigation plant, with the inse-

curity of the farmer in the rainfall region. In the latter case, during a summer drouth, the farmer goes out to see his crops, turns his eyes for the signs of rain, sees no prospect of rain, then he returns to his house and says to his wife: "We are going to lose our crop; no rain; the mortgage is overdue; we are going to lose our farm," and the only moisture around is that in their weeping eyes; but in the irrigated district, the farmer looks over his crops in field and orchard, and going back to the house says: "Wife, tonight we will open the gates and let in some water, we are going to have an abundant crop, as usual, and this year will pay off the last dollar of our debt," and in the moisture of the irrigated farm, with dry eyes and hopeful hearts, they rejoice that they control the means that make their crops.

THE FINANCIAL ASPECT.

The opportunities for investment and for making grand fortunes are great. C. P. Huntington, of the Southern Pacific Company, recently remarked that the day for making fortunes by building railroads is now passed, but that irrigation is the new industry for making fortunes, and that if he were young he would devote himself to the development of irrigation as the hopeful field for making great gains. A writer in a book published in 1886 says: "The British Government has spent about \$70,000,000 in irrigation works in India, and works were in progress of construction which would require half as much more money. The amount now invested in British America is said to be \$150,000,000. The total amount of income on the \$70,000,000 was upwards of \$5,000,000, or 7¼ per cent. on the cost. The main motive for this expenditure was to prevent famines. These schemes were successfully managed by Government, not by individuals. In our own country all such enterprises are individual enterprises."

On the financial side of the subject the following is interesting:

	Capital Invested.	Annual Revenue.
Ganges Canal.....	\$14,400,890	4½%
Punjab.....	15,671,000	5%
Northwestern Provinces.....	17,827,225	5½%
Western Inundation Canal.....	6,532,000	7½%
Eastern Inundation Canal.....	2,350,000	11¾%
Bombay and Sind.....	11,113,940	12%
Kistnah Delta Works.....	2,337,135	13¾%
Sinde Inundation Canal.....	5,980,000	18¾%
Madras.....	9,467,200	22¾%
Canvery Delta Works.....	1,468,000	36½%
Godavery Delta Works.....	3,418,525	39¾%

There are many instances of profitable investments in irrigation undertakings in our own country. I have seen a list of irrigation companies in which the increment of value is indicated by the difference between the price at which the stock was originally sold and the market price of the same after the enterprise was made to become productive of profit,

and such list shows gains ranging from three hundred to ten hundred per cent. But the most satisfactory proof is seen by the returns published in the census bulletins and by the progress report of the Bureau of Irrigation Inquiry, because such returns are of general results.

It has been said that irrigation was a many-sided subject. One important side of it relates to investment. The first cost of irrigation systems in 1889, according to the census, was \$26,611,000 and their value in 1890 \$94,412,000. Even the latter figure, representing an increase of 218 per cent. in present valuation over first cost, is inconsiderable in comparison with the sums that must be expended in the future work of reclamation:

NEW LANDS ARE NEEDED.

The constant growth from internal sources of the population of this country, and the rapid aggregation to such increase from immigration, and from the fecundity of this immigrant aggregation, tend rapidly to absorb new lands and bring them into cultivation; and it will not take long to fill the interstice between land "under ditch" which is cultivated, and the land which lies "under ditch" awaiting the husbandman. The further extension, then, of the areas "under ditch" is looked forward to constantly by the thoughtful citizen as one of the means of gratifying the ambition of the human family for a home of each man's own making.

The fact that the area of reclaimed and reclaimable land is small as compared with the territorial surface of the humid regions does not diminish its economic value in itself, while acre for acre irrigated arid lands are worth more than humid region lands.

The fact that the area of possible reclamation has two limitations of rather severely compressing boundary, namely, the measure of adequate water in the immediate locality of its distribution, and the expense of establishing the irrigation works; these two limitations remove all apprehensions as to over-extending this area of valuable reclamation, and keep up the lively hope of constant and growing profits of such enterprises.

IMPORTANT RESULTS OBTAINED.

The census of 1890 tells us that the average cost of providing means of irrigation to land in the arid region is \$8.15 per acre; that the value of land almost valueless without completed means of irrigation is raised by irrigation to \$48, and to \$60, and to \$150, on the average in regions tabulated in the census compend; that the average of yearly returns from irrigated crops is \$14.87 per acre; and, profit-showing as this average statement is, it does not do justice to the facts, since this average is made up on areas which include lands watered for pasturage only as well as lands cultivated to crops. The profit of ir-

rigation enterprise on the average, according to the census of 1890, was 283.08 per cent. This is not a showing of the exceptional profits of some enterprises, but the statement of average on all work of this kind. Like mining ventures, some of these undertakings are exceptionally profitable; while unlike mining, when not quickly or largely profitable, they are still investments in real property of growing usefulness and of increasing profit possibility.

In the irrigation of lands, and in the preparation of such lands for cultivation, something like \$200,000,000 have been invested. The indirect benefits of this investment to the country at large are many fold in value the amount of such investment.

POPULATION AND COMMERCE STIMULATED.

It is neither the grazing nor the mining interest which has contributed most largely to the influx of population into the Arid West. It is agriculture in all its forms which has largely contributed to bring this immigration into such States and Territories; and irrigation made the agriculture first possible and then profitable. The 5,500,000 of population within the area under consideration has not long been resident therein. In 1850 the total white population was 166,524. Irrigation, in its large expression, is the growth of some twenty years only; with its growth has come the population. In 1860, we are informed, there were but twenty-three miles of railroad west of the Missouri; there are now more than 40,000 miles. Of telegraph lines there were none; now some 100,000 miles of electrical communication. These commercial agencies and this gain in population have gone forward *pari passu* with irrigation as concomitants, and partly, although not wholly, as results. This, then, has been gained. A country, nearly uninhabited by white people, has increased to five and a half millions of people; an area, not large when compared with the territorial surface of the United States, but not insignificant by any rules of measurement, an area of some eight millions of acres has come into crop cultivation at greatly profitable results by artificial watering, and to this the irrigated pastures must be added; an area of some 21,000,000 of acres has been placed under immediate possibility of cultivation by providing canals, ditches and reservoirs for its reclamation. Its unoccupied portions are now awaiting the husbandman's industry and intelligent labor to pay him back large profits for his toil.

LAND OF GROWING VALUE.

It goes without saying that land producing crops without danger of failure and crops of the best quality and largest quantity per acre must rise to high value. The most valuable agricultural lands in the world will be the irrigated farms of the Arid West. This is not prophecy, but well established fact. The

returns of the census of 1890 show that the first cost of irrigated lands, with their water rights, had been \$77,490,000, and that their value at the time the census was taken was \$296,850,000, an increase of about 283 per cent.

The tendency to aggregate population in small areas of irrigated lands and the tendency to intensive cultivation brings agricultural life into higher economic conditions than can prevail in the humid region. The loneliness of farm life is done away with, close neighborhood is induced and better improvements come in, and with these conditions lands rise in value.

WHAT IRRIGATION MEANS.

The advocates for irrigation insist that the food-producing power of reclaimable arid lands and of pastoral lands not reclaimable will suffice to sustain many millions of population, and that the prediction is very reasonable that the agricultural population will be far more dense within the irrigable areas of the West than in the agricultural regions of the eastern three-fifths of the United States.

Such advocates dwell with philanthropic consideration on these features also, viz.: That irrigation means better economic conditions; means small farms, orchards and vineyards; more homes and greater comfort for men of moderate means. "It means more intelligence and knowledge applied to farming, more profit from crops, more freight and more commerce, because special products of higher grade and better market value will be raised. It means association in town life instead of isolated farms; it means the occupation of small ranches of every mountain, basin and valley, and the gradual but still rapid filling up of foothills and tablelands. It means telephones, telegraphs, good roads and swift motors; fruit and garden growths everywhere; schools in close proximity; villages on every hand;" and such general prosperity as can hardly be dreamed of by those who are not familiar with results of even the present infancy of irrigation in America. The great fruit supplies of the United States are in the future to come from irrigated areas in the arid region.

These are no fanciful predictions. There are realizations to-day, in limited regions, of the picture here presented. Time will unfold results on a magnificent scale, and a civilization, not elsewhere in the world to be exhibited in more consummate flower, will, in the progress of time, distinguish the arid region.

IRRIGATION IDEAS SPREADING.

The old-time notion that irrigation is a draw-back to agriculture is disappearing. So well educated are the people becoming through the wide dissemination

of irrigation ideas by THE AGE, that important questions relating to this subject are being considered in a great number of places and in many States. It may surprise some of our readers to learn that schemes of irrigation have actually been proposed in New England. It is believed by some practical men that land hitherto found of little value in many parts of the far East may be put under profitable cultivation by means of irrigation. The same may be said of some of the middle States, as well as of Georgia, Florida, Louisiana, Indiana, Illinois and Iowa. Kansas, Nebraska and the Dakotas have quite fully learned the advantages of supplementing their precarious rainfall by systems of irrigation. That no very extensive irrigation works have yet been established in some of the States named above is not for our present purpose important. It is merely to call attention to the fact that irrigation is here regarded as necessary or even desirable. So far as the need of irrigation is concerned, the whole United States is likely soon to be recognized as "the arid region," for it is certain that every year sees advances in the direction of controlling the distribution of the rainfall for the benefit of agriculture. It is but a very few years since the idea of irrigating crops or orchards in Florida was scouted as absurd by nearly every person in the State. To-day there are pumping and distributing plants in that State costing thousands of dollars each, and subsequent years will witness a great increase of these money-making investments. As the irrigation idea has developed, numerous experimental borings have resulted in opening a great number of valuable artesian wells in numerous places where the presence of underground water supplies was not suspected. Even on the deserts of California and Arizona artesian water has been found at reasonable depth, and regions hitherto utterly waste and barren will soon be made among the most productive areas in the world. It is more especially, however, to those regions where irrigation has heretofore been pronounced unnecessary, and advocates of it mad men, that attention is here invited. It is certainly a hopeful indication of rapid progress along the whole line of irrigation where the need of it is recognized in the older sections and among the densely populated States of the Atlantic seaboard. A public sentiment thus cultivated and matured must finally result in such needed legislation on the part of Congress as will meet the new conditions and give to agriculture throughout the Union a stimulus in the direction of larger yields from smaller areas. In short, when the people of the East shall see the value and need of irrigation in their own regions, they will aid the western men in securing a national irrigation policy.

OUR FOOD SUPPLY OF THE FUTURE.

By W. C. FITZSIMMONS.

CERTAIN so-called economists take a gloomy view of the possibility of producing food supplies for the increasing number of the earth's inhabitants. But if we take the facts and figures of annual production in the United States as a basis of reasoning, it will appear that the time is very remote when the productive capacity of the earth under usual conditions will fall below the most ample requirements of the most exacting population. It should be understood that our methods of producing the staple crops are as yet in a stage of barbarism; and this fact alone must afford good ground for a hopeful outlook in the direction of increased production as improved processes are adopted. That we are gaining ground along the line of reasonable and scientific production is certain; but when farmers burn the straw of their wheat fields and the manure of their barn-yards, as hundreds of them yet do, the march towards perfection is necessarily slow. Three hundred years ago the yield of wheat per acre in England and Scotland was probably not one-half what it is to-day, thus showing that the soil need not become exhausted even under such treatment as British farmers accord to their land. From data covering large areas it is proven that soils may be renewed and even greatly improved as the process of cultivation goes on year by year.

But to confine ourselves to conditions surrounding us here in the United States, we may draw some interesting conclusions from the following facts: During the year 1893 the total area occupied by the staple crops of wheat, corn, rye, barley, oats, buckwheat, hay, potatoes and fruit was 193,000,000 acres, or 301,000 square miles. Inspection reveals the fact that this cultivated area in the United States lacks 123,000 square miles of being equal to the combined areas of Texas and California. Throwing aside then this 123,000 square miles as waste land in the two States named, they could produce all the staples which are now grown in the entire country. To go outside the mere realm of calculation based upon areas alone, it is wholly certain that the two States mentioned could, under proper systems of irrigation, which will surely be developed in the future, produce greatly more of the crops named than the whole country produces now. And let it be understood in this connection that of the

crops grown on the area given enormous quantities were sent abroad. If it be contended that these foreign shipments were made in payment for other products not suited to our agriculture, it may be said that probably more than four-fifths of the agricultural products purchased in other countries could easily be grown on our own farms. For example: We exported breadstuffs to the value of \$187,394,840 in 1893, and imported sugar and molasses to the value of \$123,741,678, every pound of which could and should be produced in the United States. We exported meat and dairy products to the value of \$135,205,783, and bought abroad fruits and nuts to the value of \$11,471,130, while every pound of such fruits could be easily produced in California and Florida alone. And so on through a long list. To the student of the facts of production, and not merely to the theories of pessimists, it must be clear that earth's teeming millions are in much less danger of starvation individually or in masses than they were two thousand years ago, when the population was only a fraction of what it is to-day. It is clear to the man who reflects, that while the earth's population doubles itself in a century or thereabouts, the production of all the essentials of living may, by a rational and possible concert of action, be greatly increased if not indeed doubled in a single year. Assuming that only the sixty-five million people in the United States are maintained by the products of our farms, it will be seen to require three acres for each person. Assuming that the 1,500,000,000 inhabitants now supposed to be on this planet were all fed, clothed and housed as well as ourselves, the area required to yield their support would be but 7,000,000 square miles of the 50,000,000 comprising the land surface of the earth. Thus, even at the rate of production now prevailing, a cultivable territory as large as South America would feed and maintain all mankind. In view of these facts, therefore, and in face of a great over-production already in many lines, it would appear to be a waste of labor to attempt to show that mankind is in imminent danger of depletion in numbers and deterioration in mental and physical estate by reason of a lack of the essentials wherewith to feed, clothe and shelter the increasing millions of the children of men.

THE NATIONAL ORGANIZATION.

NATIONAL EXECUTIVE COMMITTEE ELECTED BY THE IRRIGATION CONGRESS AT
LOS ANGELES, CALIFORNIA, OCTOBER 14, 1893.

CHAIRMAN, Wm. E. Smythe, Member-at-Large. **SECRETARY, Fred L. Allis, Member-at-Large.**
511 Masonic Temple, Chicago. Los Angeles, California.

VICE-CHAIRMAN, Edward M. Boggs, Arizona. **TREASURER, John E. Jones, Nevada.**
Tucson, A. T. Carson City, Nev.

CALIFORNIA,	Eli H. Murray, San Diego.	NO. DAKOTA,	Dr. Merchant, Ellendale.
COLORADO,	J. F. Rocho, Hardin.	OKLAHOMA,	John H. Cotteral, Guthrie,
IDAHO,	T. D. Babbitt, Nampa.	SO. DAKOTA,	J. T. McWilliams, Aberdeen.
ILLINOIS,	Willard E. Allen, Chicago.	TENNESSEE,	P. H. Porter, Nashville.
KANSAS,	J. W. Gregory, Garden City.	TEXAS,	J. J. Walker, Barstow.
MONTANA,	Z. T. Burton, Chouteau.	UTAH,	Arthur L. Thomas, Salt Lake City
NEBRASKA,	Chas. P. Ross, North Platte.	WASHINGTON,	N. G. Blalock, Walla Walla.
NEW MEXICO,	M. A. Downing, Las Cruces.	WYOMING,	Elwood Mead, Cheyenne.

COMMITTEE ON NATIONAL LEGISLATION,
W. A. Clark, Butte, Montana.
Eli H. Murray, San Diego, California.

Richard J. Hinton, New York City.
NATIONAL LECTURER,
J. S. Emery, Lawrence, Kansas.

MORE STATE COMMISSIONS.

JUDGE J. W. GREGORY has announced the names of his colleagues in the Kansas State Commission as follows: Judge V. H. Grinstead, Dighton, Lane county; Hon. F. D. Coburn, Topeka, Kansas; Hon. L. Baldwin, Great Bend, Barton county; Hon. A. B. Montgomery, Goodland, Sherman county. This would appear to be a very strong body of men, and one amply capable of formulating the Kansas idea of wise national and State policies. Judge Gregory has at least managed his appointments well, from a geographical standpoint. All localities and all political parties are represented. Messrs. Grinstead and Montgomery attended the first National Congress at Salt Lake. Mr. Baldwin is the father of the movement to organize associations throughout the State. Mr. Coburn is the new secretary of the Board of Agriculture. Mr. H. V. Hinckley will act as consulting engineer to the State Commission.

OKLAHOMA.

Committeeman Cotteral has named W. A. Lindsey, of Perry, and M. L. Turner, of Guthrie, on the Oklahoma Commission.

IDAHO.

Committeeman Babbitt writes that the Idaho Commission met at Boise March 22d, that the laws have been thoroughly studied, and that the outlook for successful work is good. In order to facilitate the work the State has been divided into three sections, as follows:

Section 1—All the Snake river drainage west of the Wood river. The gathering of data in this sec-

tion will be prosecuted by Chairman Babbitt and Colonel Irvin.

Section 2—All the Snake river drainage east of Wood river and also the counties of Lemhi and Custer, this section to be in charge of Messrs. Mills and Morrison.

Section 3—All the drainage of the lower Snake and the counties in north Idaho, to be supervised by Mr. Ostrander.

COMMITTEE VACANCIES.

The Arizona membership has been filled by the election of Judge J. L. Van Derwerker, of Yuma, whose majority consisted of the following votes: Allen, Alles, Blalock, Cotteral, Downing, Jones, McWilliams, Mead, Murray, Smythe.

Z. T. Burton has resigned his membership for Montana. F. H. Brigham has been nominated for Oregon.

THE OMAHA CONVENTION.

The Inter-State Irrigation Convention held in the city of Omaha on March 21-22 was a decided success. There were over two hundred and fifty delegates present, representing the states of Nebraska, Kansas, Wyoming, Colorado, Montana, South Dakota and Iowa. It was an educational convention in more ways than one, and the agriculturists who were present received many practical ideas from those who have made a close study of the scientific application of water. The proceedings were harmonious in every respect and the fullest discussion was brought out on all topics that were on the programme for consideration.

SOME OF THE LEADERS PRESENT.

Among the men prominent in the irrigation cause there were present Judge Emery, the national lecturer; Hon. Francis E. Warren, ex-senator from Wyoming; Prof. L. G. Carpenter, of Fort Collins, Colo.; State Engineer Elwood Mead, of Wyoming; E. R. Moses, president of the Inter-State Irrigation Association; J. L. Bristow, secretary of the Inter-State Association; Senator Mondell, of Wyoming; Donald Campbell, of Colorado; Major J. W. Powell, director U. S. Geological Survey; Charles A. Gregory, of New York; Prof. Robert Hay, of Kansas, and I. A. Fort, of North Platte. Many of the leading citizens of Omaha and other Nebraska cities were present and gave their hearty coöperation. Among the delegates were noted Hon. Wm. F. Cody, of North Platte; Engineers Rosewater, Lawrence and Howells, of Omaha; Mayor Warner, of North Platte; J. T. O'Brien, of Kearney, Neb.; Mayor Bemis, Major Clarkson, Col. Chase, B. A. McAllister, W. N. Nason, Major Hamilton, of Omaha, and J. H. MacCall, of Lexington.

THE FIRST DAY'S WORK.

The convention opened at 10 o'clock Wednesday morning, in Washington hall. Hon. E. R. Moses, of Great Bend, Kansas, president of the Inter-State Association, was in the chair. Prayer was offered by Rev. Martin, of Kearney, and Mayor Bemis, of Omaha, welcomed the delegates with a happy speech, in which he extended to them the freedom of the city. The response was made by Mr. E. R. Moses. Mr. W. A. L. Gibbon, president of the Commercial Club, of Omaha, delivered an address in behalf of the organization which he represented, and extended to all delegates the use of the club rooms during their stay in the city. Gov. Crounse was not present at this hour, so his place was taken by Hon. William F. Cody, of his staff, who delivered a most happy speech, touching upon the benefits and needs of irrigation. "The Inter-State Irrigation Association, its Organization and Plan of Work," was the subject of Mr. J. L. Bristow's forceful address, and following this gentleman came Major Powell, of the Geological survey, who discussed "The Water Supply of the Great Plains." By a series of pictorial maps he reviewed the questions of rainfall, surfaces, soils, dry farming, public lands, etc. He spoke for over an hour and commanded the closest attention of his audience.

Hon. Francis E. Warren, of Wyoming, was the first speaker at the afternoon session. He reviewed the subject of irrigation, touching upon its rapid growth during the past two years. He echoed the general sentiment of the West that Congress was too indifferent to the needs of the country west of the Missouri, and that the time would surely come when the Great Plains would force congressional recognition. Prof.

Hay, of Kansas, and Donald Campbell, of Denver, spoke briefly and were followed by the national lecturer, Judge J. S. Emery, of Kansas. The latter gentleman is always entertaining, and he was never more so than in his bright, energetic speech before this convention. He regarded irrigation as the question of paramount importance to arid America, regardless of tariff and silver. "What are we here for?" asked the speaker. "Simply to punch up our congressman," and the applause that followed showed that the delegates were in sympathy with him. In conclusion the speaker urged general agitation for irrigation legislation.

The afternoon session was closed with an address by Prof. L. G. Carpenter on "The Duty of Water."

In the evening the delegates were entertained at the Commercial Club. Brief speeches were made and a collation was served.

RESULTS OF THE SECOND DAY.

The second day's session of the convention was fully as entertaining and instructive as the previous one. Col. Chase, of Omaha, talked on "The Duties of the Plains' Cities in the Development of Irrigation," and was followed by Charles A. Gregory, of New York, on "Irrigation and Continental Development." This address was a remarkably strong one and was full of practical ideas for the development of the arid West. THE AGE hopes to present it in full in some future issue.

Mr. Ira C. Hubbell, of Kansas City, read a paper on "Pumping Machinery for Irrigation," and Elwood Mead, of Wyoming, spoke for half an hour on the results obtained in his State.

Considerable time was taken up with the discussion of the resolutions which, briefly stated, are as follows: That Congress shall make increased appropriations to determine the volume of the underflow and to determine the extent to which reservoirs can be constructed for storing storm waters; that all farmers be urged to plant and cultivate forest trees; that the office of State engineer be created in all western States; that the meteorological stations be maintained and their number increased throughout the arid and semi-arid region; that the agricultural colleges devote a portion of their funds to demonstrate the agricultural possibilities, with and without irrigation, in the plains country. That the people organize county associations and put themselves in communication with the Inter-State Association; that able delegates be sent to Washington to urge the passage of bills now pending in behalf of the irrigation of the great plains.

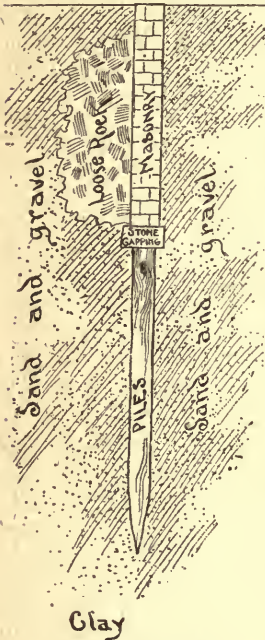
The thanks of the convention were voted all the speakers, the Commercial Club and the citizens of Omaha. The convention adjourned Thursday evening.

PULSE OF THE IRRIGATION INDUSTRY.

UNDERFLOW WORK.

AN interesting experiment along the line of underflow development will take place in Arizona. For several weeks past Gen. J. B. Weaver, representing Pennsylvania capitalists, and W. A. Hartt, of

Tucson, have been prospecting at a place about 15 miles northwest of Tucson, near Rillito station on the line of the Southern Pacific railroad. Here the Santa Cruz valley narrows to about two miles in width, from what is called "Point of the mountains"—at the north end of the Tucson mountains—to the high mesa lands. The Santa Cruz river flows through here, being an underground stream. After passing the "Point" the valley suddenly widens, making a body of land that will average ten miles in width and 30 to 40 miles in length that can be irrigated. Preliminary work is going on in the



FOUNDATION PLAN.

shape of wells sunk at different points across the bed of the dry stream, to ascertain the depth of the water level, which has thus far proved to be twenty-seven feet from the surface.

The next step will be to ascertain the quantity of water that can be developed. This will be done by sinking a machinery pit or well twenty-five feet in diameter as deep as seems necessary to get a full water supply. This pit will be walled up with stone. Two mammoth pumps will be placed in the pit at a depth of twenty-five feet from the surface. The pumps are now being constructed by the Smith-Vaile Co., of Dayton, Ohio, and will be ready for operation about June 1st. Their capacity is 5,000 gallons per minute each, and it is expected that enough water will flow into the pit to supply these pumps for continuous pumping. This being demonstrated, all will

be in readiness for the construction of the dam across the river.

CROSS SECTION OF SANTA CRUZ RIVER.
2 MILES FROM POINT TO POINT



The method of construction to be followed, as will be seen by accompanying diagram, is, first, an open cut will be made about two miles long, the entire width of the river bed, and twenty-seven feet deep. From this depth sheet piling forty feet long will be driven as close together as possible. On top of the piling a stone capping will be laid and on this a 24-inch stone wall laid in cement. Near the center of the wall an opening, or spill way, will be left to carry off the accumulated water, its width depending on the water developed. On the upper side of the wall loose rock will be thrown to a width of six feet to provide for the easy flow of water to the surface. The experimental plant now being put in will cost about \$20,000, and the whole plant about \$250,000, exclusive of ditches.

SESSION TO THE STATES.

Senator Carey of Wyoming has introduced a bill granting to each of the arid land States and Territories a million acres each of the public lands to be sold to settlers in lots of 160 acres each. The commissioner of the general land office endorses the bill in the interest of settlers. He says: "Local and community interest, under State control, will stimulate results with far greater zeal and success. The principal proposition involved—reclamation and settlement by individuals in small holdings—meets my strong approval, and this bill seems to me to present full opportunity for the practical experiment and under proper safeguards. The United States retains title until reclamation is accomplished and the land occupied by actual settlers. This, if successful, is the great object to be obtained."

Indian creek reservoir dam, in Idaho, went out on the 13th of last month. Considerable damage was done between Bysuka and Caldwell and the railroad bridges in the neighborhood of Nampa were swept away. The dam cost \$50,000. It is stated that the work of reconstruction will be started as soon as practicable.

A GOOD IDEA.

Other colonies will do well to follow the suggestion of the following circular. More colony superintendents are needed.

EDDY, N. M., Feb. 26, 1894.

Mr. Jas. Hartigan has been appointed Colony Superintendent, with headquarters at Vaud, N. M., reporting to the undersigned.

He is expected to advise with all old and new settlers, giving them the benefit of his experience as to the laying out of their land, method of irrigating, the planting of crops, and in general assisting them in any way he can.

It is hoped that all settlers will call upon him freely for advice, to the end that his labors may be mutually beneficial.

This appointment in effect March 1, 1894.

CHAS. B. EDDY,
Gen'l Mgr.

THE NAVAJOES AND WATER.

Gen. McCook's statement that Congress will appropriate, at its present session, the sum of \$50,000, to be used in developing water for the use of the Navajo Indians upon their reservation, will be joyfully received by the stock raisers of western New Mexico. This is in line with Agent Plummer's report, which was quoted from at length by Gov. Thornton in his recent annual report presented to the secretary of the interior, and which presents vital statistics to back up the suggestions made by the agent in charge. It is estimated that the Navajoes own 1,000,000 head of sheep, 250,000 goats, 1,000 head of cattle and 100,000 ponies, and that they marketed during the past two years about 1,000,000 pounds of wool per annum.

IN AID OF IRRIGATION.

Secretary Hoke Smith has approved of a draft of a circular which will soon be issued governing the applications for right of way over public lands for canals, ditches and reservoirs. The right is held to extend only to construction, and no public timber or material will be allowed to be taken or used for repair or improvement. The department ruling of March 21, 1892, holding that natural lakes, already sources of water supply, shall not be used for reservoir purposes, nor rivers be dammed so as to overflow into adjacent country is overruled.

KEEP THE MONEY AT HOME.

Secretary of Agriculture Morton in his annual report dwells at length on the importance of making this country independent in the matter of agricultural imports. He shows that many of the agricultural products for which we now send abroad could be raised upon our own soil, in proximity to our own

markets. Fruits, nuts and wine, tobacco and sugar, fibres used in making cloths, all these and many other articles can be produced in different sections of the United States and the money expended for them kept at home instead of being spent abroad. And what is true of the United States as a whole is true of many of our states. We are continually buying ourselves poor, draining money out of these new states to purchase articles that should be produced here. The secretary's idea should be widely inculcated.

EASTERN IRRIGATION.

Irrigation is becoming so well understood in the East that many horticulturalists are either adopting it as a system or are getting ready to adopt it. Lewis Cowing, near Muncie, Indiana, tried it on his blackberries last season. When he found his crop threatened by drouth he bought an engine which he placed in a well, and which was propelled by natural gas, which enabled him to irrigate a large portion of his patch. His well seemed inexhaustible, and enabled him to produce a good crop of the most perfect berries. The gas engine, with pipe, cost \$90, but it saved a crop worth \$300. On a few rows not watered the fruit was worthless; on watered plants the yield and quality were the best he ever saw. When the blackberries ended he turned the water on celery with the best of results.

ON THE MUSCATINE ISLAND.

In a paper read before the Academy of Science on "Irrigation on the Muscatine Island," Mr. J. P. Walton says: "It is possible that the time will come when much of the island will be irrigated with artesian wells. Abundance of flowing water can be reached at a depth of 900 feet. This water flows at a pressure of about 60 pounds. Before using for irrigating it can be used for mechanical purposes, such as generating electricity for domestic purposes, lighting, heating and cooking. It will cost something to get this water supply, but when the coal and wood supply fails, this great subterranean lake that nature has stored away for ages will be very liable to be brought to use.

NO MORE EXPERIMENTAL STATIONS.

It has been reported that Congress will not make appropriations for continuing the work of the agricultural experimental stations. From the annual report of the secretary of agriculture mention of these institutes was omitted, and when the matter was called to the attention of the secretary, he explained, that as the department was not given supervision over the stations, he did not think their expenses should be charged to the department in the appropriation estimates.

KEARNEY'S BOND PROPOSITIONS.

The city council of Kearney, Neb., has passed an ordinance to submit to the electors of the city a proposition to vote \$60,000 of five per cent. twenty year bonds for the purpose of increasing the capacity of the present canal from 2,000 to 9,000 horse power and supplying the necessary head-gates, weirs, etc. These bonds are to be negotiated and sold by the city and the proceeds deposited in the city treasury to be paid to the canal on vouchers and estimates approved by the city engineer. The canal company agrees to furnish the city of Kearney free of charge for twenty years, electric lights or power to the value of \$3,000, and all water needed for flushing sewers and irrigating public and private grounds of the city for a term of 87 years. The basis for figuring the value of electric power is the rate now charged or that may be hereafter charged at Niagara Falls, or the cheapest price for electric power in any of the five largest cities in the United States. The canal company also agrees to furnish the manufactories at a maximum rate of \$20 per horse power per annum.

Another ordinance was passed by the council to submit a proposition to vote \$15,000 of five per cent. twenty year bonds to construct a system of water works to take water from the canal.

CONVENTION AT HURON.

A convention was held at Huron, S. D., on the 8th of last month. The subject of irrigation from artesian wells was thoroughly discussed, and all were of the opinion that more wells should be put down as soon as possible. A permanent organization was perfected, with the following officers: R. B. Hassell, of Redfield, president; Asher D. Pay, of Huron, secretary, and S. W. Narregang, of Aberdeen, treasurer. A committee was appointed to prepare an address to the people of the State, and plans were outlined for securing State and national aid in perfecting a practical system of irrigation for South Dakota.

IN FIRST-CLASS ORDER.

The plant of the Prosser Falls Irrigation Co. in Washington is now in good working condition and the farmers in that section are correspondingly happy. A large number of people were present last month, when the test of one of their great pumps was made, and all pronounced it more than satisfactory. Another large pump is being put in place. The company is working Victor turbines and Smith-Vaile pumps, furnished by the Stilwell-Bierce & Smith-Vaile Co., of Dayton, Ohio.

A. C. Powers is putting in an irrigation reservoir on his farm west of Garden City, Kansas.

IN THE DAKOTAS.

Mr. S. W. Narregang, writing from Aberdeen, S. Dak., says he has 200 acres of his 2,000 acre farm under ditch and ready for irrigating this season and expects to have 200 more in shape shortly. The Dakota Irrigation Company is sinking a large well at Newark, in that State, for running a 75 barrel flour mill. A six-inch well at Edgely, in North Dakota, is about finished.

SHOULD HAVE HAD CREDIT.

The paragraphs used in the March issue of THE IRRIGATION AGE on "The Birth of Irrigation in Kansas" were taken from "The Progress of Irrigation," as prepared by J. W. Gregory, of Garden City. Inadvertently, THE AGE failed to give that gentleman credit for the same.

The Mesilla Valley Irrigation Colony Company filed articles of incorporation with the territorial secretary. The incorporators are Nathan E. Boyd, of England; W. T. Thornton, of Santa Fé; A. M. Loomis, E. V. Berrien, E. C. Roberts, P. E. Kern, J. L. Campbell, of El Paso; W. S. Hopewell, of Hillsboro; Phœbus Freudenthal and Henry Bowman, of Las Cruces.

The company is organized with a capital stock of \$250,000 to lay irrigation pipes, establish a colony, etc., in the Mesilla valley. The charter also authorizes the company to build houses, lay out towns, establish banks, etc. The principal places of business are at Las Cruces, El Paso, Albuquerque, Chicago and New York.

E. C. Rittsher, M. E. Miller and W. H. Holcomb are the incorporators of a Chicago company known as "The Land of Sunshine Company," organized to sell 40,000 acres of agricultural and fruit lands in Central California now owned by the Southern Pacific Railroad Company. The land is in the picturesque San Joaquin valley. It has formerly been devoted to standard agricultural products, but it is especially adapted to fruit growing, for which it will be used. The railroad and the land companies will combine in giving the tract a good substantial boom.

A box factory has been established at Williams, on the Atlantic & Pacific road in Arizona. It is turning out 4,000 boxes per day, which are being shipped to California, where a contract for 200,000 boxes has been entered into with the Orange County Fruit Company. The company will turn out 6,000 boxes per day when everything is completed.

Fully 1,000 acres will be set out to prunes in Stevens county, Washington, this spring.

The people on lower Tongue river in Montana are getting after the owners of the big dam at Miles City, for failure to construct a fish way therein as required by law. The matter was brought before the last grand jury, which, although it returned no indictment, gave the owners a very broad hint which they will do well to heed.

The Chicago *Post* has of late been paying considerable editorial attention to the subject of irrigation. In a late issue it treats of irrigation in western Kansas, and speaks most encouragingly of the benefits to be derived from a proper application of water to the soil.

The lands of the Crocker estate and the Crocker-Huffman Land & Water Co., in Merced county, Cal., have been purchased by Eastern parties. The amount involved is stated at \$5,000,000. M. F. Hatch, of Chicago, and M. B. Davis, of Detroit, are two of the purchasers.

A tract of land adjoining the town of Farmington, San Juan county, New Mexico, has been purchased by a syndicate of gentlemen in Durango and laid off in five acre tracts, which will be sold to parties wishing small fruit farms.

Within a few days it is understood a colony of some 25 families will leave Elgin, Ill., for American Falls, to be settled on lands recently located near the falls by a big syndicate.

Clemens Herschel, one of the leading hydraulic engineers in the country, has been making an examination and will shortly give his opinion as to the rebuilding of the Indian Creek dam in Idaho.

The *Los Angeles Herald* has a forceful article on the need of more truck gardeners. It claims that the profits are large and the demands for California vegetables are rapidly increasing.

Articles of the Payette Canyon Ditch Co. have been filed with the Secretary of State of Idaho. The object is to take a ditch out of the Payette above Emmett.

Testimony in the matter of the priority of water rights under the Platte and Beaver canal is being taken by Referee Bennett at Greeley, Colo.

An estate of 4,000 acres lying near Ritzville, Washington, has just been divided up and put on the market in tracts suitable for small farms.

A new town called Orangedale is to be built in the Salt River valley, near the falls of the Arizona canal.

Mr. F. W. Smith, of the Rio Mimbres Irrigation Company, Silver City, New Mexico, has received information from Chicago that some thirty families will come out in the spring and take up about 7,000 acres of the land owned by the company and irrigated by it. These people are for the most part farmers and will improve that section of Grant county, raising products for the local market as well as that of Silver City.

As a result of the World's fair exhibit of the Pecos valley, N. M., a colony of sixty families has already been organized to cast their fortunes in that locality. They sent one of their number—Dr. W. H. Morgan—to investigate the merits of the enterprise. His report was listened to by a large and enthusiastic party in the parlors of the Palmer House. His description of the country more than sustained the representations made of this famous country.

The preliminary survey of the Farmers' Union ditch, to be taken out of Boise river about five miles below Boise City, is completed. A meeting of the interested parties will be held this month, when the engineer will submit a report as to the cost.

Prof. L. G. Carpenter, Commissioner Penney and Assistant Meteorologist Trimble have been at work rating the Poudre river. Below the head of Greeley No. 2 ditch they found three feet per second flowing, and near the mouth of the stream fifty feet. The increase is mainly from seepage.

A section of land under the Pioneer canal, near Pecos, will be planted to cotton this year. Cotton grows well all over the valley, but in the New Mexico portion farmers will not plant a product that sells for such an unremunerative figure.

A colonization plan has been perfected in Mesa county, Washington, whereby colonists may buy land payable on yearly installments, interest at 8 per cent. payable semi-annually.

A Colorado colony from Weld county has located at Wheatland, north of Cheyenne. They have bought 1,600 acres under irrigation, paying at the rate of \$15 per acre.

The world's hop crop for 1893 is given at about 146,000,000 pounds, of which 210,526 bales of 190 pounds each, or say 40,000,000 pounds, were produced in the United States.

An authority announced that the State of Washington would send at least 1,000 carloads of fruit to Eastern markets the present year.

CANAL NOTES.

Arizona.—There is talk of reviving the Antelope canal near Tacua.....D. M. Munroe has been appointed assistant construction engineer on the Big Gila dam.....Four-fifths of the stock of the Highland Land and Water Co. is owned in Basle, Switzerland, and Swiss colonists will settle the lands under the leadership of Julius Bernoulli.....The enormous dredger of the Consolidated Canal Co., at Mesa, is at work and has a capacity of a million yards in twelve months. A local paper gives the following description of it:

"This dredger is a desert curiosity. Measuring 46 feet in width by 86 feet in length, it weighs 200,000 pounds and carries 175,000 pounds of machinery. Yet it draws only $2\frac{1}{2}$ feet of water and stands about that height above the surface. The boiler registers 60-horse power and drives a 50-horse power engine. The crane by which the dipper or digger is forced to do its work measures eighty feet in length and weighs probably fifteen tons. Four men operate the huge monster at an expense of about \$50 for every twenty-four running hours."

The canal is 8 miles long, 45 wide on the bottom, and the average depth of excavation required is 20 feet.

California.—The directors of the Modesto irrigation district will advertise for bids for completing their main canal.....The directors of the Turlock district will soon advertise for bids to complete their main canal.....The Oakdale Irrigation Co. will partially rebuild their dam on the Stanislaus river.....A Chicago company with a capital of \$1,000,000 has been incorporated for the purpose of acquiring of the Southern Pacific Railroad Company a 40,000 acre tract of land in the San Joaquin valley and placing it on sale, under the name of "The Land of Sunshine Company."

Colorado.—Men who rent irrigated farms are to be met every day in Lamar. Most of them are from the so-called rain-belt regions, and they are good farmers.....The new 1,000 acre reservoir west of Eaton has been completed. It will water an entire township.....Work is about to be commenced upon the enlargement of the Greeley and Loveland canal. It will be enlarged so as nearly to double its present irrigating capacity.....Land in the vicinity of Grand Junction which was sold two years ago for \$10 an acre, recently sold for \$200 an acre planted in orchard.....Farmers of Mesa county have at last decided to buy the big irrigating canal. They pay \$40,000 in 6 per cent. twenty year bonds.....At Fruita, land which a few years ago could be had for nothing now sells for \$50 an acre for orchard planting. Some Leadville parties paid \$3,500 for 80 acres recently.....Mesa county has over 1,000 miles of irrigation ditches.....High water the coming spring will find the Avoca irrigating plant fully prepared for it.....Work on the People's reservoir at Fort Collins is nearly completed.....Joseph A. Osner, of Denver, has commenced work on the tunnel and ditch of the Loveland and Greeley Canal Company.....Senator Galloway, of Bed Rock, Colo., is constructing a dam across the Dolores river for the purpose of obtaining sufficient water to irrigate a large body of land lying along that river. The dam will cost \$20,000.....The Naturita Canal and Reservoir Company, of Shenandoah, have a force of men at work constructing an irrigation ditch in the Dolores mountains.....Careful estimates place the first cost of constructing the system of ditches, reservoirs, laterals, etc., now in use in the Poudre valley alone, at not less than \$1,500,000 and the annual outlay for repairs, additions and management amounts to a princely sum. The system extends from near the canyon of the North fork to where the Poudre river forms a junction with the Platte, a distance of about fifty miles, and covers a strip of country that is twenty miles wide in places.

Idaho.—The Prosser Falls Irrigation Company is putting in flume to water about 4,500 acres of fertile soil. Three water wheels, larger than those at Tacoma or Spokane, are being put in at the river bank, about a quarter of a mile from the depot, and

from them is being constructed a flume ten by twelve feet in size, about 400 feet long, into which the water will be raised by these mammoth wheels one hundred feet above the river level. The plant will soon be put in readiness for operation.....W. P. Trowbridge, the engineer, has prepared for the owners of the Ridenbaugh canal maps of Boise valley showing the entire irrigation system of Ada and Canyon counties, giving the elevations and other valuable data.....The parties interested in the construction of the new ditch on the north side of the Payette river were notified to appear before the State Land Board and present argument on their petition for a relinquishment of about 5,000 acres of state lands located under the proposed canal.....The Boise City and Nampa canal will be deepened and new head gates and weirs are to be constructed.....A. J. Wiley, who has charge of the immense Bruneau dam and canal enterprise, owned by the Owyhee Land and Irrigation Company, says the prospects of the company for 1894 are very bright. The great dam on the Bruneau river is, he says, in excellent condition, discharging over its long crest an immense volume of water. The canyon work has been completed, making one of the finest and strongest pieces of canyon canal work in the West. The dimensions are as follows: Bottom width, 80 feet; top, 45 feet; depth, 6 feet; with a capacity of 26,000 inches. The steel head gates are in place ready to admit the waters of the Bruneau as soon as the lower portion of the canal is completed.

Kansas.—Among the irrigation plants in course of construction in Kansas, probably the most extensive is that of Mr. G. M. Munger, of Eureka, Greenwood county. He is constructing a reservoir which will cover about 160 acres with water. This is done by building a dam 2,800 feet long and thirty-eight feet high at greatest height. The water will be raised by two compound steam pumps, the water cylinders of which are twelve by fifteen inches. Each pump has ten-inch suction and eight-inch discharge. These pumps will elevate the water to a height of sixty-five feet, delivering it on the highest part of Mr. Munger's farm. The estimated cost of the plant complete, including ditches for distribution of the water, is \$15,000.

Nebraska.—The city council of Kearney voted \$60,000 of bonds to the Kearney Canal and Water Supply Company. The canal is to be widened to 85 feet on the bottom.....When the Nine Mile canal is finished in Cheyenne county, Bayard will be in the center of the best irrigated portions of the Platte valley.

New Mexico.—The large dam at Hard Scabble has been completed.....The Model canal at Farmington is being enlarged.....The McJunkin canal at Farmington is being extended.....The Pecos Valley Co., at Eddy, have 121 miles of main canal, 273 miles of laterals, and 900 miles of sub-laterals, a total of 1,294 miles.

Utah.—Utah has 3,000,000 acres of arable lands, watered by 1,000 miles of canals. One canal, that of Bear river, cost \$2,000,000. The irrigated lands produce annually 6,000,000 bushels of grains. There are over 3,000,000 cattle, and the mines in 20 years have produced \$150,000,000 in gold and silver.

Washington.—At Prosser a canal eleven miles in length, to serve 3,000 acres, is under construction. A pumping plant lifts 15,000,000 gallons daily for irrigation use, besides serving the town and giving power for an electric plant.....At Seattle, A. H. Dawson and others are sinking an artesian well for irrigation water in the Sunnyside district.....The Kittitas valley canal will be built this year.....The Oregon-Washington Irrigation Company has completed arrangements for constructing reservoirs in the Blue mountains for the storage of water for use in Asotin county.....Okanogan county will not lag behind. A move is on foot to improve 60,000 acres by means of irrigation.....The Wenatchee, Pine Mission and Brown flats are likely to be watered by a ditch starting at Peshastin creek and running along the south side of Wenatchee river. The surveys have been completed.

NEW COMPANIES.

Arizona.—Articles of incorporation of the Guaymas Water Supply Company, Limited, have recently been filed at Tucson, Ariz., by H. T. Richards, E. M. Richards and Geo. Montague. Principal offices of the company will be at Nogales, Ariz. It is proposed to furnish water for the town of Guaymas, State of Sonora, Mexico, and for the irrigation of lands in the vicinity of Guaymas, also for the construction and operation of street railroads. . . . A water storage company has been organized at St. Johns. . . . People in the vicinity of Kingman are erecting windmills and water tanks to irrigate land.

Colorado.—The survey for the big ditch on North river, near Julesburg, is being pushed rapidly forward. The ditch will start near Oshkosh, Deuel county, and will run to North Platte. It will be about 80 feet wide. . . . The bond of Contractor Dodge has been filed with the State engineer. It would seem that the construction of a State storage reservoir at Saguache is now a settled fact. . . . Fort Collins is to have a new storage reservoir on Crow creek. . . . The Florence Improvement Company, Florence, Colo., to institute and manage electric plants, etc., in Florence and Cripple Creek. Capital stock, \$400,000. Incorporators, W. E. Johnson, W. K. Johnson, A. R. Gumaer, W. Kuff and J. E. Rockwell.

Nebraska.—The people of Cedar Valley will sink a test artesian well. . . . There are 250 miles of completed canal around Gering and the citizens have united them into one association. . . . The Niobrara River Irrigation and Power Company, of O'Neill, filed articles of incorporation on the 18th inst. with the following well known business men of O'Neill and Atkinson as incorporators: A. U. Morris, R. R. Dickson, J. P. Mann, T. V. Golden, Neil Brennan, G. C. Hazlett, O. F. Biglin and J. A. Testman of O'Neill, and Dr. J. L. McDonald and H. A. Allen of Atkinson. The authorized capital stock is \$2,500,000, divided into \$100 shares, at least \$10,000 of which must be paid up before commencing business on April 2, 1894. It is expected that their system will irrigate at least one million acres.

New Mexico.—Articles of incorporation of the Zapato Irrigation Company have been filed. The incorporators are August E. Rouiller, Philip Mothershead, James W. Mitchell, William W. Jones and Charles G. Cruickshank, all of the county of Sierra. The capital stock is \$100,000; single shares, \$100. The principal place of business is Engle, Sierra county. The starting point of the canals is at Mitchell's dam, near San Marcial, and thence the main lines radiate, one on the west and the other on the east side of the Rio Grande valley. The canal will be about 127 miles in length, and will follow the base of the foothills on either side, irrigating a tract of land of an average width of about one and a quarter miles.

Utah.—The Marysville Reservoir Company has filed articles of incorporation. The incorporators are Jas. A. Chute, William M. Hicks, Chas. A. Ames and Willis A. Ames of Salt Lake, and James A. Melville of Filmore. The capital stock is fixed at \$300,000, divided into 300,000 shares of the par value of \$1 each, which are taken. The officers are Charles A. Ames, president; James A. Melville, vice-president; James A. Chute, treasurer, and Willis A. Ames, secretary. The company will establish dams for the storage of water and the reclamation of arid lands on the east side of the Sevier river, near Marysville.

Washington.—It is reported that a large amount of Dutch and Italian capital has been enlisted in an irrigating ditch to be put into the Yakima county in the spring. . . . The new map folder of the Sunnyside lands shows a railroad projected from Mabton on the N. P. R. through the central portion of the great irrigated belt, via the town of Sunnyside and on to Zillah.

COURT DECISIONS.

Liability for Assessment of Stock.—Where a corporation sold some of its stock for payments of assessments, and bid the same in, in which the stock-holder acquiesced it cannot on its own motion treat the sale as invalid, and reinstate the stockholder, so as to render him liable for the assessment. *Patterson v.*

Brown & Campion Ditch Co. (Court of Appeals of Colorado.) 34 Pac. Rep. 769.

Appropriation of Water Rights.—The right to the use of water flowing in a stream may be acquired by actual appropriation, without compliance with the provisions of the statutes, for acquisition of water rights. *Watterson v. Saldunbehere.* (Supreme Court of California.) 35 Pac. Rep. 432.

Liabilities for Injuries by Water.—Where a company collects large quantities of water on its premises for its own purposes, and discharges the water upon the bed of a street, in consequence of which the lot of an abutting owner is flooded, it will be liable for the injury thereby occasioned. *Baltimore Breweries Co. v. Ranstead.* (Court of Appeals of Maryland.) 28 At. Rep. 273.

Liability for Maintaining Ditch.—Where an irrigation company uses a ditch already in operation, and extends a new ditch beyond the terminus of the old one, the owners of the old ditch are not liable for the cost of maintaining the new portion. *Patterson v. Brown & Campion Ditch Co.* (Court of Appeals of Colorado.) 34 Pac. Rep. 769.

RECENT PUBLICATIONS.

"The Right of Appropriation and the Colorado System of Laws" is the title of a valuable work recently issued from the press. The author is Judge Harvey Huston, a man of much legal talent, and one who has devoted a great amount of time and study to a consideration of the subject upon which he writes. The volume is not only valuable for all lawyers in the arid regions, but it should be in the hands of all members of corporations and farmers. It treats of the subject in an exhaustive manner, as may be seen by glancing over the table of contents, which is as follows: The right of appropriation; the regulation of the right of appropriation; the adjudication of priorities; right of way—eminent domain; rates of charges for water; duties and liabilities; offenses and penalties; divisions and districts; officers and their duties; rights of towns, cities and counties; ditch and reservoir companies; irrigation as to desert and State lands. This is the first complete classification of irrigation laws so far as Colorado is concerned, and, in fact, no attempt has been made to that end since 1886. The volume will be of service to readers in any section of the arid West on account of its treatment of the common law principles of irrigation. For sale by Chain & Hardy, Denver, Colo.

"Engineering Results of Irrigation Survey," by Herbert M. Wilson, has just been issued from the government printing office. It is the most valuable work that has been sent out from this department for a long time in the line of irrigation. The author is a close student of irrigation development. He is familiar with the systems of the old world from personal examination, and has also investigated all the principal enterprises in this country. The volume is profusely illustrated and contains matters of engineering character that make it of special value.

PATENT REPORTS.

514,559. Machine for measuring water from lakes, by William T. Lambie, of Los Angeles, Cal. Filed July 26, 1893.

514,616. Water elevator, by George W. Campbell, of El Paso, Tex. Filed Aug. 16, 1893.

514,639. Suction and force apparatus for pumping fluids, by Waitman M. Morgan, of Kansas City, Mo. Filed Oct. 5, 1892.

514,767. Device for protecting riparian lands from overflow, by Wm. McCaughan, et al, of Gulfport, Miss. Filed March 23, 1893.

514,848. Windmill, by Frank W. Eaton, of Ness City, Kan. Filed March 31, 1893.

515,378. Proportional water meter, by John Thompson, of New York. Filed May 11, 1893.

515,408. Windmill, by Charles B. Putnam, of Marion, Iowa. Filed March 25, 1893.

515,630. Hinge for windmill rudders, by Fred Waldner, of Mishawaka, Ind. Filed May 27, 1893.

515,693. Composition for boring or drilling tools, by Olaf Terp, of London, England. Filed Feb. 17, 1893.

COLONY BUILDING.

ON IRRIGATED LANDS.

SPACE will soon be found in these pages for an adequate presentation of the fascinating subject of colonial development in connection with irrigated lands. It is the plan of THE AGE to devote much attention to this matter during the current year, because nothing else is so vital to the growth of the arid regions. A large, though scattered, area is under ditch and awaiting the coming of settlers. The time is ripe for an extensive movement of population. The thing to do is to direct it into the right channels. This is to be accomplished by a campaign in the East aiming at the popularization of the irrigation idea, and by the persistent presentation in the West of wise plans looking to the development of attractive colonies. One means by which the latter object may be facilitated is the rehearsal of the history of the most successful colonization efforts on record. Another means is the publication of ideas and plans that will be advanced from various sources.

THE AGE invites the coöperation of its readers in this branch of its work. What attractive features can be incorporated in plans for colonies? What are the most effective means of finding settlers? What can be done to find new markets and increase the average prosperity of those who till the soil? These questions must be answered. Let us have the assistance of the Man with an Idea.

A COLONIZING SCHEME.

Interesting Methods Adopted for Settling Lands in Moxee Valley.

An interesting plan of western colonization has been put in practice by the managers of the Pacific Artesian and Land Company, of Tacoma, Wash., who are reclaiming a large tract of land in the Moxee valley, eight miles east of North Yakima in that State. Their proposition to the home-seeker is, in brief, as follows: A tract of land, ranging from 20 to 80 acres, with water right, is leased to the colonist for half of his gross crop or proceeds from the same. This one-half crop is to be applied, first, to payment of taxes, and second, to payment of interest; the balance applies on the purchase price of the land. This plan is carried out year by year, and when this half-crop payment amounts to the sum total of \$100 per acre, interest, at 7 per cent., and taxes from the time of making the lease, then a deed and free water right is given the lessee, free and clear of all incumbrances. The 7 per cent. interest clause does not go in force until one year from date of lease. One good feature

of this plan is, that it allows the settler to have the use of all the ready money that he may have, as there are no cash payments to be made, and he can apply the same to the improvements on his farm. At the same time, it is a good thing for the company.

The plan thus far has worked very nicely, and, during the last month, it is understood that a large amount of land has been disposed of to settlers on the line of this proposition.

WYOMING COLONIZATION.

Recently, a number of letters have been received, asking for particulars concerning the colonization of the Wyoming Development Company's lands, and THE AGE trusts that the following information will be satisfactory. The construction of the canals of this company was begun about eleven years ago and completed about nine years ago. Further progress in the occupancy of this land has been postponed by controversy with the government over the title to the lands. On the settlement of this controversy measures were taken to carry out the original plans of the company, to make the lands reclaimed the homes of small farmers. It has now been in progress about three months. Already 135 families have secured homes, the area embraced in their purchases being 13,238 acres. All, or nearly all, are from Greeley, Colo., and vicinity. They are practical irrigators, and were attracted to these lands by the offer of the company, which disposes of the canals in connection with the lands, and makes the farmers the owners and managers thereof.

The company is now preparing plans for the utilization of a number of natural reservoir sites, the largest of which will have a superficial area of between six and seven hundred acres, and will be covered to a depth of between twenty and forty feet.

WILL WORK FOR KANSAS.

A new organization has recently been incorporated under the name of the Kansas Immigration Company. The purpose of the association is to secure for Kansas its share of the immigration which yearly moves westward. The by-laws of the company prohibit it from buying property and its sole efforts will be devoted to induce home-seekers and investors to come to Kansas. The main office is at Topeka and the officers are as follows: President, J. A. Troutman; vice-president, J. E. McLeod; secretary, John Q. Royce; treasurer, F. G. Willard; manager, C. H. Edgcombe.

HORTICULTURE BY IRRIGATION.

THE OUTLOOK FOR FRUIT.

AMERICAN civilization has reached a point where a fruit crop becomes of great moment. So long as we lived largely upon pork and potatoes the question of a large or small crop of fruit was of minor importance. Happily, that day is past. Every year makes the fruit crop more important and the loss of it a greater deprivation, if not, indeed, a calamity. Probably no other staple crop is subject to greater vicissitudes from climate and other conditions than the produce of our orchards. But the people of the United States are learning to consume fruit, and its need is very greatly felt in seasons of scarcity. The cold weather prevailing in many sections during the past winter has seriously threatened the peach crop in a number of the best districts east of the Rocky mountains, and at the present writing the outlook for peaches is not a hopeful one. Reports from Kansas, Missouri, southern Indiana, Michigan and parts of Maryland and New Jersey indicate a light crop or a total failure. In addition to the severe weather, the mercury sometimes going to 20 degrees below zero, is the more serious fact that the severe weather followed in several extensive districts a season of unusually warm weather which caused the fruit buds to swell, in some instances almost to the point of blossoming. The two conditions resulted in great damage in many places, and a total destruction of the crop in some localities. Thus far, however, our advices from the Pacific coast region are favorable to a large yield of nearly all varieties of fruit grown there. The winter was favorable in most places, and if the usual weather prevails from now forward there will be no scarcity of fruit for eastern shipment from California. It is expected that improved methods of transportation and refrigeration will be put into use this year, which should go a long way toward putting the California fruits into the eastern markets at a much more mature stage and in better condition than formerly. This is greatly to be desired, and if our California friends shall succeed in giving us fruits with a high flavor as well as a bright color, no doubt they will find the demand equal to their ability to produce—but we must have good fruit, picked at the proper time and delivered in good condition on our tables. These are the problems before fruit growers of the Pacific coast, and if they shall solve them successfully they may speedily look for ample rewards.

It is reported from California that fruit growers are disposed to pin their faith to the Rev. A. T. Per-

kins, of Alameda, near San Francisco, who has patented a device for transporting fresh fruits to almost any distance in first-class condition without the aid of ice. Speaking broadly, his invention consists in introducing air (which has been greatly condensed in reservoirs by means of air pumps operated by the locomotive) through diminished pipes or valves, into an air-tight chamber containing the fruit. The expansion of the air lowers the temperature, and only a dry, pure air thus comes in contact with the fruit, arresting decay and precluding the development of fungus growths in transit.

Experiments on a small scale seem to assure the success of this system of refrigeration, thus doing away with the eight tons of ice required under present methods, and also dispensing with a considerable part of the extra weight of refrigerator cars. Like most inventors, however, Mr. Perkins needs funds to fully complete his system, and a move has been lately made among fruit growers in that State to raise the required amount and put the system into early operation. The present methods of refrigeration and preservation of fresh fruits in transit are quite unsatisfactory, and if Mr. Perkins' new system shall prove a success the people of the East will rejoice as well as those of the Pacific coast.

VARIETIES OF FRUIT.

A Colorado Horticulturist Tells as to the Most Profitable

Mr. W. C. Steele, in his paper before the Mesa County (Colo.) Horticultural Society, gives some valuable suggestions as to varieties of fruits profitable to plant. He says:

"In some countries some varieties of small fruits are rejected because of liability to mildew. In our arid climate it is unknown. Varieties of apples that fail in some places succeed well here.

"Then if we were to plant for home use, we would plant other varieties than those which have proven most profitable for market.

"The apple, now second only to the peach in importance, and liable to become first in the estimation of our fruit growers. There is but one most profitable variety—the Ben Davis. I have tried to retain prejudice against this popular variety, but as long as one-fourth my orchard is all Ben Davis trees and one-half the apples Ben Davis apples, I must recommend Ben Davis for profit. My next most profitable, and for the first five years after planting, out-yielding the Ben Davis, is the Missouri Pippin. Then comes that

beautiful showy apple, the Lawver, or Delaware Red Winter. The Geneton and Winesap are also profitable and of good quality. To describe the merits of the varieties I shall recommend will take too long, so I shall give a brief list of such as have proven themselves most profitable in my experience, naming in order of merit:

"Summer apples—Early Strawberry, Chenango, Carolina Red June, Sops of Wine.

"Autumn apples—Jonathan, Oldenburg, Fall Winesap, Rambo, Wealthy.

"Winter apples—Ben Davis, Missouri Pippin, Lawver, Geneton, Winesap, Grimes Golden, Minkler, Willow Twig.

"Pears, summer—Bartlett, Clapp's Favorite, Congress.

"Autumn—Keiffer, Anjou, Angouleme, Flemish Beauty, Sheldon.

"Winter—Lawrence, Winter Nellis.

"Peaches, early—Arkansas Traveler, Alexander.

"Medium early—Hale's early, Mountain Rose, Foster.

"Medium—O. M. Free, Yellow St. John, Hill's Chili, Wager, Wheatland.

"Medium late—Elberta, Globe, Stump the World, O. M. Cling.

"Late—Wonderful, Lemon Cling, Smock Free, Susquehanna.

"European grapes—Black Hamburg, Tokay, Blue Malvoise, Cornichan.

"Raspberries—Cuthbert, Gregg.

"Currants—Cherry, White Grape, Red Dutch.

"Gooseberries—Houghton, Industry.

"Strawberries—Sharpless, Jucunda, Capt. Jack, Wilson.

"The planter may experiment at will, for were my orchard confined to varieties herein named, it would be more profitable than it is. My experience is in fruit growing in sandy loam, too low for sweet cherries to be profitably grown and too warm for blackberries to withstand the winter's sun. The California varieties of grapes require protection in winter, my ground being too flat and wet to check growth in time for wood to mature. If you have Grand valley land, plant trees, all you can care for."

AN IMPORTANT CROP.

Cranberry culture is attracting considerable attention in Oregon and Washington. Several hundred barrels of excellent fruit have been produced the past season, and the industry is being extended. It is alleged by those competent to judge that the Pacific coast cranberry is in every way equal to its congener of Cape Cod.

The marshes in the latter region, which annually yield about 150,000 barrels of berries, are regarded

worth \$500 to \$1,000 per acre now, while a few years since they were looked upon as nearly worthless. The amount of available cranberry marsh in the two States of the Pacific northwest is, no doubt, many times that already under cultivation in the Massachusetts region, and its product will soon attract attention. Recent investigations of the cranberry market in great Britain are said to justify the hope of selling a very large quantity of the fruit to the English people. Should this extended market be realized, the culture of cranberries in some sections of the arid belt may be undertaken with success. One of the principal drawbacks to the industry in other places is the expense of appliances for flooding at proper times, which could be readily overcome in the irrigated regions.

ADVANTAGES OF MIXED ORCHARDS.

Investigations and experiments have led to a better knowledge of conditions governing the production of certain varieties of fruit which formerly were little understood. For example, it is known that certain varieties of fruit trees bear self-fertilizing blossoms, while others do not. Among pears we find that the Doyenne, Le Conte, Kieffer, Buffum, Flemish Beauty, Seckel and Tyson are self-fertilizing and may be safely planted in masses comprising but a single variety. But the Bartlett, Anjou, Clapp's Favorite, Clairgeau, Sheldon, Mt. Vernon, Lawrence, Howell, Louise Bonnade, Jersey, Souvenir du Congres, Winter Nelis, Rose, Easter Beurre and Superfine are not self-fertilizing and should be planted near other fructifying varieties. A very safe rule in planting a pear orchard, for example, would be to plant alternate rows of different varieties, this giving the advantage of the near proximity of trees capable of fertilizing the blossoms of other varieties not so well endowed by nature. While the wind is a potent factor in the distribution of the pollen of many kinds of fruit trees and plants, the pollen of the pear tree is not thus conveyed. This tree must rely upon the visits of insects to scatter its pollen and fertilize the blossoms. The honey-bee is here, as elsewhere, the most useful and efficient instrument for transmission of pollen from the blossoms of the pear. In this connection it may be mentioned that unfruitful pear orchards have sometimes been rejuvenated and placed on the list of profitable orchards by merely bringing a few hives of bees within easy reach. It may be said, however, that it sometimes happens that cold, rainy or windy weather during this critical period keeps the bees indoors and prevents the fertilization of the blossoms, thus entailing the loss of a crop.

As a general proposition the honey-bee may be regarded as the fruit grower's friend, though some are disposed to charge her with puncturing certain varieties of fruit and sucking the juices therefrom. Apiarists of high repute deny the possibility of this and doggedly allege that the bee takes only that which has been prepared for it by wasps or other insects.

TALKS WITH PRACTICAL IRRIGATORS.

GARDEN IRRIGATION.

By C. C. HUTCHINSON.

THE pretty village of Susanville, California, lies on the eastern slope of the Sierra Nevada mountains, at the foot of a noble wood-crowned cliff which overlooks Honey Lake valley stretching forty or fifty miles eastward.

At the head of Main street are two residence lots, which illustrate the power of a little water when properly applied to good soil. In one lot a rich blue grass lawn occupies the space in front and on two sides of the dwelling, only broken by the walks and a few flowers and flowering shrubs, while a small garden extends from the rear of the house to the overhanging cliffs.

At the base of the cliffs throughout the town, and at many similar positions and altitudes throughout the valley—4,200 feet above the ocean—are noble sprawling oaks, while 100 feet higher begin the inter-

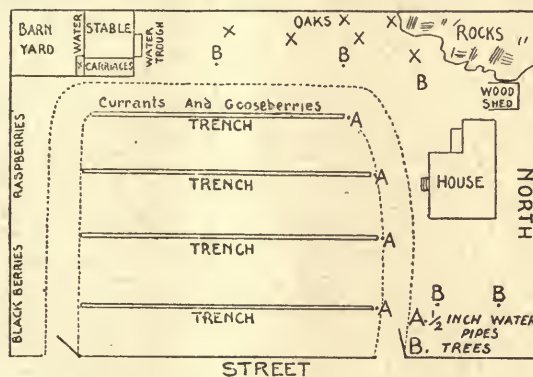
and 30 inches wide. The earth was scattered on the upper side of each cut, and by a little care in plowing the garden was terraced into slopes of less grade, each 100 feet long and 28 feet wide. As a driveway passes along each end of the terraces, nearly all the cultivation is done by a horse, turning on the driveways.

The trenches are designed as miniature reservoirs, and are kept nearly full, when irrigation is required, by a small stream flowing from one-half inch stand pipes at one end of each trench. The ground is free from stone and was originally covered with sage brush, which sufficiently describes the land to those who are familiar with the fertile, friable, easily irrigated soils indicated by such natural growth. These trenches prove quite sufficient to irrigate the garden, in the long, dry summers of this region, and ground which would not mature white beans, rye or buckwheat produces heavy crops of sweet corn, tomatoes, peas, strawberries and all small fruits—asparagus, celery, potatoes, onions, melons and, in short, the usual variety of first-class gardens. In the middle of the lower terraces, and occasionally about the grounds, are planted a few family fruit trees: apple—for which this valley is famous—pear, cherry, plum, peach, prune and apricot.

The size of the stream filling each trench is incredibly small. By my actual measurement, with a gallon measure, each trench is supplied by the flow of three quarts per minute; each one of these little streams thus irrigating a strip of land 28 feet wide and 100 feet long. Where water is taken from a stream or open ditch it is certain to carry more or less sediment or vegetable matter, although it may look clear. Unfortunately, this is the case with our water works, as the spring water flows through an open ditch a considerable distance before it is piped over town.

In this instance, as in all similar cases, allowance must be made for the effect of such sediment in puddling the bottom and sides of the trench. At first this would be hardly appreciable, but the water continually standing would, in time, materially retard the seepage. This, however, is not objectionable. The trenches above described were kept full about one-half the growing season, but if the seepage was so retarded that they must be kept full all the time, no harm would result.

The system requires some extra labor, but it is all expended at the beginning when you lay out your



minable pine forests. The town is abundantly supplied with water from a distant spring, and gardens throughout the place are usually irrigated by water flowing in open ditches. But the above named grass plat and garden is watered by spraying. Upon the lawn this works well, but upon the sloping face of these gardens the water sometimes gathers in rills, which form disagreeable little gullies.

The adjoining grounds, of which I would particularly write, also have too great a slope for spraying, and instead of providing ditches through which water flows, the owner constructed permanent trenches, which have no outlet except by seepage. These trenches extend 100 feet in length along the face of the slope, each being 18 inches deep

garden. No matter what you do in handling water it *pays* to do it well by permanent works at the start. I cannot imagine any more thorough and economical system of garden irrigation than is herein described. If adopted in a region where occasional summer showers occur, movable wooden troughs might be provided for carrying the overflow from one trench to another, to be placed in partially prepared cuts across the middle of each plat or terrace.

Among the advantages of the above system, are:

1st. In the long run, or say even for three years, it is the cheapest system on heavy grades.

2d. It is the most thorough application of water.

3d. The water is warmed by the sun before it is applied to the ground—a very important matter.

4th. It irrigates the lower as well as the upper part of the soil.

5th. It runs day and night without trouble.

6th. You have no mud in the garden, no washing away of soil or plants, and you can work the ground any time.

7th. Each trench acts as a drain for the ground above it, whenever you stop the flow of water from the pipes.

8th. By what other system can so small a flow of water be made practically available for irrigation?

In any soil through which water will percolate this plan is worthy of a trial where the ground has a slope appreciable to the eye.

Instead of iron pipes the trenches may be filled from a ditch by the use of small wooden troughs, preferably buried for convenience in cultivation.

MONTANA RESULTS.

What has been Accomplished on Some Irrigated Farms.

Mr. I. D. O'Donnell makes some interesting statements in his report to the Montana State Irrigation Society concerning what has been accomplished on irrigated farms in Yellowstone county. He says:

"The valley tributary to Billings, known as the Clarke's Fork valley, is destined to be the great feeding center of this section of country. Alfalfa hay can be furnished at from \$3 to \$5 per ton, which is cheap feed for the stockman and leaves a handsome remuneration for the farmer. The farmer can raise from four to six tons of alfalfa to the acre and can harvest it for less than \$1 per ton.

HOW TO GET LAND.

A man can buy land on time, and, by irrigating, without further cultivation can raise sufficient natural blue joint hay to pay for his land in three crops. This is not guess work but has actually been done, and is being done at the present time. By paying \$1 per acre down, \$1 per acre for fencing, he

can purchase land under ditch. For \$80 he can obtain water to irrigate the whole farm and the second year he can cut 160 tons, or one ton per acre of natural blue joint hay, which will net the farmer \$5 per ton on the cars at last season's prices. He will pay for his farm in the three crops, and have land worth \$25 per acre for his profit.

GOOD CROPS AND A MARKET.

The land grows magnificent crops of wheat, oats and potatoes, which have been the crops chiefly grown, and the quality is unsurpassed. Barley grows well, and the dry season at harvest time insures it against discoloration, so objectionable to brewers. Bright barley, equal to the best California or Canadian product, will one day be a staple crop. Hops grow wild in many parts of the valley, and it would naturally follow that hop culture may be an important industry of this valley. Small fruits and vegetables grow to perfection and always command a good price, as beside the local demand there is a call for these products from Anaconda, Butte, Helena, Bozeman, Red Lodge, etc. Melons do well and have a fine flavor. Corn grows abundantly, 125 bushels having been raised on an acre. Experiments have been made with broom corn, peanuts, ground cherries and sweet potatoes, and they have been grown successfully, but only in small quantities.

WHAT WAS DONE LAST YEAR.

Hesper Farm (Bailey & O'Donnell, Billings, Mont.) consists of 640 acres. In 1893 100 acres used as pasture; 200 acres to alfalfa, cut about 1,000 tons in three crops; 200 acres in blue joint and timothy, from which cut 200 tons of hay, which was baled and shipped at \$9 per ton; 100 acres to oats, which produced 168,000 lbs.; sold surplus oats at 85c. per cwt.; 100 bu. wheat; 100 bu. corn; 30,000 lbs. potatoes; 50 bu. apples; 320 qts. currants; 500 qts. berries, and all vegetables needed on ranch for the year. Bought 150 inches of water at a cost of \$300. One man did all the irrigating, which for the season did not amount to over 2½ months' work. This winter they are wintering 10,000 head sheep at 50c.; 1,100 calves at \$2.50 and 100 horses at \$10.

Daniel Lamey, Billings P. O., on his homestead of 160 acres produced in 1893 the following: Alfalfa, 100 tons; 50 tons of blue joint hay, which he sold loose for from \$8 to \$9 per ton; 5,000 lbs. potatoes; 22,000 lbs. oats; 240 bu. wheat off seven acres; sold 780 lbs. butter at an average price of 33½ cents; 312 dozen eggs at an average of 30 cents, besides raising all vegetables needed for his family and some to sell. Is wintering 50 head of stock. Bought 35 inches of water at a cost of \$70. Himself and small boy did all the work.

HE DESIRES SOME INFORMATION.

One of the patrons of *THE AGE* sends in the following question, which he desires published. Any answers sent to this office will be forwarded to the gentleman.

Have any of the readers of *THE AGE* data on underflow development for irrigation purposes?

First—The place, and the amount of water developed; the general plan of works, length, size, whether open cut, flume or drain tile.

Second—The amount of surface flow prior to underflow operations; width of stream or source of supply; extreme depth below supply water; character of soil or gravel bed from which it is taken; grade of stream bed per mile; grade of underflow work per mile; if drain tile or boxes covered, did any water pass over or was all water drained to level of opening; was the supply of water greater or less at different times of the year?

GOVERNMENT SEEDS.

The following item from R. J. Hinton of New York is suggestive: "An attack on the government seed distribution is now the prominent feature of Morton's agricultural statesmanship. Doubtless there is waste, and even the secretary's Nebraska farm is not conducted without some of it. But there is another side to the tirade on the seed business. An orchardist in southern Colorado raised 1,600 bushels of apples the past year from a ten-acre orchard. He refused \$4 a barrel, or \$6,500 for the crop. And it is stated also that the main varieties grown in that orchard, as in so many others in Colorado, grew originally from grafts or seeds imported from Russia, by the United States Department of Agriculture and distributed free by a 'paternal' government. The Russian variety of apples, so distributed for instance, has alone added a number of millions a year to the taxable values of the west and northwest, yet it cost for distribution but a few thousand."

IRRIGATED POTATOES.

Judge J. M. Stout, who is now farming in Washington under irrigation, has this to say in reference to raising potatoes by irrigation:

"The first step towards a good potato crop is to get the land in good condition. As soon in spring as it will do to go to work, turn on the water and get the soil well moistened. Following a season like this, a heavy watering will not be necessary. I presuppose the land in good condition last fall. When the soil is right, put in the plow, and plant as you plow. Do not let the land bake. Drop potatoes in every third or fourth furrow.

"I prefer cutting to a single eye and placing six to

eight inches apart, according to variety—Early Rose, six inches; Burbank, eight inches.

"I prefer to cover the seed four to five inches. Harrow after the planting and follow with a smoother, or light roller. This leaves the surface in fine condition for the after cultivation. Lay off a ditch between the rows for irrigating. This may be done after the potato plants appear above the surface.

"When to first turn on the water, watch for indications of getting too dry. When that stage is reached, turn on the water and let it run for twenty-four hours, then stop the flow; and when the land has dried out enough to permit, run through with a small shovel plow. This done, the ditches must be reopened to be in readiness for the next watering. The next time water is needed let it remain about the same time as before and follow with a small diamond plow, throwing the dirt toward the potatoes. A third watering and cultivating will be needed. Do not neglect the cultivating whether there be weeds or not. The soil needs the stirring. The last time will be along about the 1st of August. Treated in this way, one will be sure of a good crop of potatoes."

THEY GIVE SATISFACTION.

The Union Gas Engine Co., of Los Angeles, continue to have good success in the sale of their engines and pumping plants. Some of their recent sales have been as follows: J. S. Killian, El Monte, Cal., 12 horse-power pumping plant; T. K. Underwood, Whittier, Cal., 6 horse-power pumping plant; Pacific Coast Oil Co., Newhall, Cal., 12 horse-power oil engine; Charles Hollenbeck, Manzanita, 12 horse-power pumping plant; Emil Gotleiber, Los Angeles, 4 horse-power pumping plant; Joseph Baylor, Los Angeles, 4 horse-power oil engine; Crescent Coal Co., Los Angeles, 4 horse-power pumping engine and 4 horse-power hoisting engine; Las Fuentes ranch, Santa Barbara, 3 horse-power hoisting engine; Keystone Mining Co., Manvel, Cal., 12 horse-power hoisting engine. Complete information as to the success had with these plants can be obtained by writing the above parties.

PROFIT IN BEET SUGAR.

The Watsonville, Cal., beet sugar factory has just closed its annual run, having reduced 65,400 tons of beets raised in Santa Cruz and Monterey counties, for which was paid \$5 per ton, or \$327,000, to the producers. From this product was obtained 7,800 tons of raw sugar, which, at \$60 per ton, would give to the factory for the season's run \$468,000.

New York advices state that Eastern capital will be interested in the irrigation enterprise at McCook, Neb. An expert has been sent to make an examination.

THE COFFEE TREE IN THE UNITED STATES.

IN a recent issue of your paper you state that the coffee tree will not endure hot sunshine during the first two or three years of its growth. I think you are in error as to this statement. It was my fortune to spend several years on a coffee estate in Ceylon, and I never found that the sun affected the young plants provided there was sufficient rainfall, and in this country irrigation would insure plenty of moisture. In that country we raised the plants in the nurseries from seed, and when the seedlings were seven or eight inches high, transplanted out of doors. While in the nurseries, however, great care was exercised in keeping them sheltered from the sun. At three years the young trees would begin bearing, and at five years would be in full bearing. A coffee estate requires the employment of a large number of people in picking, pruning and weeding, the latter being a heavy item of expense, as every inch of ground must be kept clear of weeds by hand picking, as any implement is liable to injure the roots.

In Ceylon we paid our skilled labor what would be equal to 25 cents in American money; common laborers got 20 cents, and women and boys 15 cents per day. In this country, where labor is so well paid, I do not think it could be made a profitable industry. I would suggest trying, *Cinchona*, which merely requires weeding, and at three years could be made to yield some profit. I sincerely hope that the California experiment station will take up this matter.

C. S. HANDCOCK.

HINT TO THE FARMERS.

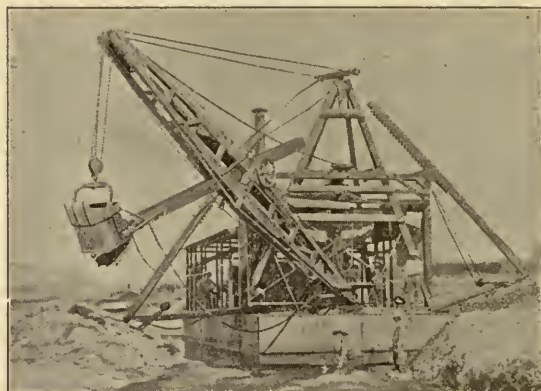
Mr. G. Meese, of Spokane, Wash., says if the farmers in that vicinity will raise broom corn he will supply the market. He wants all farmers raising that crop, or intending to try it, to write him. Mr. Meese is in the broom-making business and he wants to patronize the western farmer instead of being compelled to send East for his supplies.

RAPID DITCHING.

In 1890 Dr. O. J. Chandler, of the Consolidated Canal Co., of Mesa, Ariz., decided to use modern machinery in the construction of the company's ditches, and, after thorough investigation in this direction, contracted with the Marion Steam Shovel Company, of Marion, Ohio, for one of their medium sized ditching dredges, which was constructed and put in operation early in 1891. This machine proved extremely serviceable, from the fact that in enlarging the old ditches they could keep the water running at all times while the enlargement was being made. The material being cemented gravel, loose rock, sand and earth, with large cottonwood, mesquit and willow

stumps to contend with, the operation of the dredge in all its work was highly successful, the work being done for a small per cent. of former methods.

The accompanying cut is from a photo taken while the enlargement of the ancient canal was being made. The Consolidated Canal Co. found this investment so satisfactory that they have recently entered into a



THE DITCHER AT WORK.

contract with the same company for the construction of a mammoth dredge, having a hull 84 feet long and 46 feet wide, equipped with a boom 80 feet long. This dredge has a large capacity, and is capable of excavating to a depth of 25 feet below the surface of water, raising and dumping the material 34 feet above surface of water, and at a distance of 80 feet from center of dredge on either side. With this machine they can complete their largest canals with one cut. With this addition to their plant, the work of irrigation can be carried on more rapidly, and what has been considered an arid, worthless country is fast becoming a land of productivity, peculiarly adapted to fruits, grains and grasses.

"It is expected that the Chino, California, factory will also start out in its '94 campaign with a capacity of 1,000 tons of beets per day, being on an equal footing with the Watsonville factory," says the *Champion*.

After a thorough canvass and intelligent agitation of the proposition, the people of Kittitas county, Washington, have signed contracts to plant 2,500 acres in sugar beets this season.

Mr. Blackwell, of Hunter, Idaho, is preparing twenty acres of land for fruit, and the Greer Bros., of the same place, are preparing a large acreage for prunes.

The Island Farm Company has been incorporated in Seattle, Washington, with a capital stock of \$50,000.

FARM GOSSIP.

Hop growing in California, Oregon and Washington has proven to be a lucrative industry and the aggregate yield of the three states is large. The Pacific coast hops command a good figure generally, but some experienced growers believe the crop is often harvested too early. A prominent grower in Washington writes to a local paper that the highest success in hop growing is gained only when all the conditions are properly observed. He alleges that though a crop may have been properly planted and diligently tended throughout, if not picked at the right period of maturity a great falling off in quality and price is almost sure to result. This grower alleges that, generally speaking, the picking is begun too early and before the plant is fully matured. He cites his own experience in corroboration of his views. He finds that by picking about ten days later than usual fully 30 per cent. in weight is gained, and, also, a considerable percentage in quality. The following suggestions regarding the proper time to pick hops may prove of value:

"It is the mass of hops that should show ripeness, not selections alone here and there. There is more intrinsic value developed in the last few days in the life of a hop upon the vine than in a month's previous preparation for the fruitage.

"Ripe hops will be well closed at the points; will be harsh to the touch and solid, not flimsy and soft; will be of a rich golden color, or will have a strong tinge in that direction. Of course, the seed will be solid and thoroughly mature, though many of these can be found in a yard where the mass of hops is unfit to be picked."

THE potato crop of the United States during the past two years has not been equal to the home consumption, though our wheat and cattle crops have been enormously in excess of demand at reasonable prices either at home or abroad. In 1891 the largest crop of potatoes ever grown yielded 240,000,000 bushels, while that of last year was 150,000,000 bushels, and that of the present year somewhat less.

OVER \$1,000,000 is sent out of the State of Washington every year for dairy products. This in the face of the fact that we have in all parts of the State unexcelled ranges, pasture lands and all kinds of grasses for feed. Butter always brings from 20 to 30 cents a pound, while in the East 10 to 20 cents will buy the best. Which brings the most profit: wheat at 40 cents a bushel or butter at 25 cents a pound? Will some rancher please answer?—*Tekoa Globe*.

IN the agricultural schools and colleges of Europe forestry is made an important study. With us it receives almost no attention at all.

ELECTRICITY AND VEGETATION.

The Latter May be Influenced to a Great Degree by this Power.

This formed the subject of a most interesting and instructive lecture which was delivered in the Horticultural Hall, Boston, recently by Professor L. H. Bailey, of Cornell University, before the members of the Massachusetts Horticultural society. Professor Bailey said among other things: The electrical forces which influence vegetation are of two general types—the electric light, which is simply a method of illumination, and electric currents, which are a means of electrification. We may feel sure that illumination at night will not injure the plant, and as it has long been proved that artificial lights exert much the same influence upon plants as the sunlight does, only in a smaller degree, we shall expect that good results will follow in proportion as the energy of the artificial light approaches the energy of the solar light.

The electric light commends itself above other artificial lights because it is the most powerful. The spectrum of this light is that of carbon combined probably with certain products of combustion. It contains the same parts as the solar spectrum and in approximately the same proportions; but it is richer in the ultra-violet rays, and probably somewhat weaker in the orange rays. It is pretty well ascertained that the orange portion of the solar spectrum is particularly promotive of the assimilative power in plants. This fact suggests that the use of an orange globe for the electric light would bring its spectrum nearer to that of sunlight.

EFFECT OF AMBER GLASS.

Our experiments with color screens show that an amber glass, the nearest approach to orange in commercial glass, gave more rapid growth or earlier results than other colors; but it is doubtful whether the assimilative power of the ordinary electric light is sufficient to render minor modifications of the visible portions of its spectrum practically appreciable in plant growth.

If the electric light, therefore, is similar to sunlight in essential effects upon plants, it remains for us to discover two things: Does the light contain injurious properties along with illumination? Are all plants equally susceptible to its influence?

I may say in reply to these questions that from the results of experiments tried by me it appears that plants exposed too closely to the electric light are injured, while at a proper distance the same kinds of plants receive more or less benefit. The question whether all plants are equally susceptible to its influence I answer in the negative, after experiments with endive, spinach, cress, peas, carrots, lettuce and other plants. Upon the first four the effect varied, while upon carrots it seemed to be wholly injurious.

LETTUCE BENEFITED.

Lettuce, however, was greatly benefited by the electric light. It was found that under the protected light, running all night, lettuce had made a better growth than in normal conditions, but when the light was burned only the first half of the night it showed still greater difference. Three weeks after transplanting lettuce of equal age upon the benches of the light and dark houses the plants in the light house were fully 50 per cent. in advance of those in the dark house in size, and the color and other character of the plants were fully as good. The plants had received at this time $70\frac{1}{2}$ hours of electric light. Just a month later the first heads were sold from the light house, but it was six weeks later when the first heads were sold from the dark house. In other words, the electric light plants were two weeks ahead of the others. The gain had been purchased by $161\frac{1}{4}$ hours of electric light, worth, at current prices of street lighting, about \$7.

This experiment was repeated by reversing the houses for the purpose of eliminating errors, and the results were essentially the same. Seeds were sown in plots on February 24, 1891. Until March 17 they were grown under ordinary conditions, at which time they were set in their permanent positions in the two compartments. We began to pick lettuce from the light house on April 30, but the first of equal size from the dark house was obtained on May 10. The electric light plants were therefore upon the benches forty-four days before the first heads were sold. During this time there were twenty nights in which the light did not run, and there had been but eighty-four hours of electric light, worth about \$3.50. This gain of ten days in maturity is remarkable when we consider that the light never ran later than 11 o'clock at night, that nearly half of the nights had no light, and that the experiment was made late in the season, when the strong sunlight would tend to obscure any effect of the artificial illumination. These results were uniform throughout a house 20 x 30 feet in extent in both instances. All subsequent experiments strongly confirm these results, and nothing can be more definitely stated concerning the effects of electric arc light upon vegetation than that a 2,000 candle power lamp, run half the night, or even less, exerts a most marked beneficial influence upon lettuce throughout a house 60 feet square. In fact, I consider this point so well determined that we have discontinued experiments in the general forcing of lettuce by the electric light.

EFFECT UPON FLOWERS.

The influence of this naked light upon the productiveness and color of flowers was found to vary with the different species and different colors within the same species. Several named varieties of tulips

gave interesting results. When these came into full flower, it was found that in every case the colors were deeper and richer in the light house; but the colors lost their intensity after four or five days, and were then indistinguishable from those in the dark house. The plants in the light compartment had longer stems and larger leaves than the others, and there was a greater number of floriferous plants in the light. These tulips were grown at a distance of 10 or 12 feet from the lamp. Petunias were much affected by the light. The plants were much taller and more slender in the light, even at the farthest corners of the house, 20 and 30 feet from the lamp, and they bloomed earlier and more profusely. When the specimens were in full bloom, it was found that the height of plants in the dark house was to the height of those in the light house as five to six. White petunias were not changed in color by the light, but purple ones quickly became blue, especially near the lamp. Other flowers behaved differently, each according to its kind; but all those, of whatever species, which stood within 5 or 6 feet of the naked arc, were injured. Flowers opening near the light were of short duration, but those 10 or 12 or more feet away did not appear to be modified in this regard.

HASTENED BLOOMING.

But it was apparent that in general the light hastened blooming, and caused the production of longer stems, but this effect was much obscured by the injuries resulting from the unscreened arc. Subsequently we found that the use of a globe or pane of glass will avert the injuries to flowers as well as to foliage; and the long stems and open inflorescence, together with some increase in earliness in some cases, may be obtained without fear of injury. Yet we are not ready to recommend the electric arc lamp for the growing of flowers. If the noxious effects of the electric light can be overcome by the interposition of glass, it remains to determine whether the light cannot be hung above the house to advantage, the glass roof acting as the screen. A lamp, surrounded by a globe, was hung six feet above the middle of the glass roof, and lettuce, endive, beets, radishes and spinach, and other plants, were grown beneath. The lamp was so arranged that half the house had no electric light, while the other half received the full glare of the arc. The lettuce, as usual, was a week to ten days earlier in the lighted compartment, and the effect was marked in the remotest corner of the house, 40 feet from the lamp. Endive, which had been injured in other experiments, now showed no bad results, although it did not appear to be benefited; but radishes, which had been among the plants most seriously injured in all our experiments, now showed for the first time a decided gain in the light compartment.

WATER POWER AND ELECTRICITY.

ELECTRICAL POSSIBILITIES.

IT is not an extravagant statement to say that never before in the history of the world has there been a scientific discovery about which centered such magnificent dreams as are being built up on certain recently discovered electrical principles. "Among these the foremost place," says the *Springfield Republican*, "must be given to the astounding discoveries of the young Servian genius, Nikola Tesla, which are so novel and so extraordinary that the most imaginative of inventors are unable to foresee what form their development will take. Just as experimenters were beginning to think that they knew all that could be learned about electricity, and that further improvement must be in the line of more perfect mechanical application, Mr. Tesla shows us the electric fluid under conditions in which it differs from ordinary electricity as much as light differs from heat. A current of 2,000 volts will kill a man in the twinkling of an eye, but this modern wizard lets currents pour through his hands with a potential of 200,000 volts, vibrating 1,000,000 times a second and showering from him in dazzling streams of light. For some time after the experiment ceases his body and clothing emit streams and halos of splintered light.

"Equally astounding, and with more visible usefulness, is Mr. Tesla's discovery that currents of such enormous potential and frequency can be transmitted without the use of wires. A room can be filled with electricity from copper plates in ceiling and floor, so that electric lamps will burn without any connecting wire as soon as they are brought in. In the same way intelligence and power may be transmitted without a circuit, doing away with the necessity for trolleys, storage batteries and subways. Mr. Edison thinks we shall yet be able to get electricity direct from coal, a discovery compared with which the philosopher's stone is a mere bauble. Then our steamships will need only 'a snug little bin for 250 tons of coal, instead of one for 2,800 tons.' Successful aerial flight, electric cookery, a trans-atlantic telephone, a real telescope with which one can see around the world by the medium of a wire, the formation of wholesome food products under the potency of electrical affinities—these are some of the things which imaginative inventors foresee.

"When one contemplates such possibilities the prospect of leaving this sphere induces a regret not unlike that of the French nobleman during the reign of terror. 'I don't mind dying,' he said, tranquilly, as he took his last pinch of snuff at the guillotine,

'but, hang it all, I wanted to see how it all comes out.'"

NIAGARA OF THE SNAKE.

Proposed Plan to Harness Shoshone Falls.

The belief is expressed by many who are in a position to know that the time is not far distant when the great falls of Shoshone, the Niagara of the Snake river of Idaho, will be used to supply power for manufacturing and other purposes.

New developments in the scheme to operate an electric railroad between Shoshone and the falls tend to confirm that belief.

Negotiations have been in progress for some time regarding this road, and, recently, State Treasurer Hill received a letter from a New York capitalist, who became interested in the enterprise some time ago, stating he was satisfied money could be raised, not only to build and operate the road, but to put in an extensive electric plant to furnish power for mines and manufactories which the same men would, doubtless, put in operation as soon as sufficient power was assured.

The length of the proposed electric railroad will be forty miles, and if it be built, Shoshone Falls will shortly become one of the leading summer resorts of the West.

LIGHTNING AND TREES.

L'Electricite gives the results of experiments made by Mr. Dimitrie, in which he subjected different pieces of wood to the sparks from a Holtz machine, and found that they conducted quite differently; oak was easily pierced, while beech was quite resisting; the richness in water did not seem to have any influence, while the amount of oil contained was of great importance; woods containing starch and but little oil, like the oak and poplar, have much less resistance than those containing oil, like the beech; pine contains oil in the winter, but is very poor in oil in the summer, when it resists only as much as the oak; by extracting the oil with ether, the woods are as easily pierced as those containing starch; those containing starch are less easily pierced when living than when dead; the bark and the foliage in all the trees are poor conductors. The conclusions are in accordance with observations, as in a certain case one hundred and fifty-nine oaks were struck by lightning as against twenty-one beech and fifty-nine pine trees; the danger of being struck as compared with beech is five for Norway pine, thirty-three for pine and forty-eight for oak.

PUBLISHER'S DEPARTMENT.

HOMESEEEKERS AND KERN COUNTY.

THE march of the home-seeker into the fertile valleys of California moves on apace. There never was a time since irrigation became a factor in the industrial life of this State when progress was so marked as in these spring days of 1894. There are many reasons for this. One of them is that millions of people realized for the first time at the World's fair last summer the substantial basis on which the fame of California rests. They saw in the beautiful State building, whose very architecture carried a suggestion of things semi-tropical, the meaning of that well-worn phrase, "The glorious climate of California." They realized that climate has a com-

property of the Kern County Land Company, at the head of the San Joaquin valley. It is perfectly natural that this company should receive hundreds of applications from home-seekers at this time. It is the proprietor of the greatest irrigated farm in the world, which is now being divided into thousands of little irrigated farms. It is watered by a colossal irrigation system, which is at the same time remarkable for its simplicity. The lands are held at prices much below those asked for the small tracts in other parts of the State; as in the case of the larger enterprise it is desirable to encourage a more rapid settlement. It is well to consider what the settler can most profitably



THIRTY ACRE TRACT OF ALMONDS, ONE YEAR OLD.

mercial value in connection with the products of the soil. This stupendous advertisement gave force and point to that desire which exists in almost every mind—the desire to some time visit the Pacific coast.

The second great reason for the present movement is found in the dormant industries of the East. Thousands of people who have been uniformly busy heretofore find themselves in partial or total idleness. They have money enough to buy a small farm, but not money enough to enable them to live without steady employment. The result of these two influences is a large emigration from the eastern States to the irrigated districts of California.

THEY ARE GOING TO KERN DELTA.

One of the localities which is conspicuously before the eastern mind in this connection is the great

grow, and the list of productions covers a very wide range.

A TYPE OF CALIFORNIA.

Kern county is very fairly representative of California in soil, climate and possibilities of development. All the advantages are seldom concentrated at one point, and there are places in Southern California which present some advantages that are less marked in Kern county. Such localities, however, always have compensating disadvantages—very frequently meagerness of water supply, or the high cost of making it available. The soil and climate are good enough everywhere on the coast, but the water supply for irrigation purposes is the great indispensable factor. Kern county is abundantly blessed with water, not only in its large river, but in numerous

natural lakes and artesian basins. All the substantial advantages available anywhere are offered here.

With the single exception of citrus fruits, everything can be raised in Kern county that will grow anywhere on the coast. Oranges and lemons will grow there, too, but are not produced for commercial purposes and probably will not be, except at a few points along the foothills.

THE THEORY OF DIVERSIFIED FARMING.

When a family settles down on a twenty or forty-acre tract in Kern county, upon what lines does it proceed to make a living? Nine-tenths of the people who come to California look to the fruit industry as their principal means of support. The average farmer in Kern county will depend upon peaches, apri-

on twenty acres, and still better, if a farmer has sufficient capital and help, upon forty acres. A very small garden patch will supply a family with vegetables and small fruits the year around. A few acres of alfalfa will keep a modest number of horses, cows and swine. All sorts of poultry, including the turkey for Thanksgiving, take care of themselves very readily on such a place. Enormous crops of grain can be produced on these lands by irrigation. When the fruit trees come into bearing it will probably be better to buy flour, because it can be more economically produced on a larger scale, but during the first few years, when money is precious and time of no value except as it may be applied on the home acres, it is decidedly better to produce everything possible, up to the utmost limit, from the little homestead itself.



THIRTY ACRE ORCHARD OF FRENCH PRUNES, ONE YEAR OLD.

cots and prunes for his permanent income, but it takes time for the trees to come into bearing. Furthermore, the idea is growing every day that the sensible way to farm is to first make sure of producing as nearly as possible everything the family consumes. Families who do this are at least independent. Industries may be idle and markets prostrate, but families so situated cannot by any possibility fail to live comfortably. The writer has no doubt that upon so small an area as ten acres, in the sunny climate of the Kern delta, families can produce what they will eat in the course of the year, together with some surplus to exchange with the store-keeper for the things they must wear. This can be done with industry and economy upon ten acres, but it can be done better

A dollar saved is a dollar earned most truly in the case of the new settler who is trying to lay broad and deep the foundation of his prosperity.

THE SURPLUS PRODUCT AND A COMPETENCE.

Next after the provision for what is consumed by the family comes the production of the surplus, which must be sold in order that the proceeds may go to the credit of that competence which the farmer will need to educate his children and provide for old age. There is a wide range from which to choose in planning this part of the operations, but the matter should be carefully thought out. A few years ago raisins were the favorite crop, but they have ceased to be as profitable as formerly. Kern county is famous for its

peaches. They have never yet failed to earn good returns. Prunes make a very promising crop. They grow very rapidly and produce prodigiously here. Olives are a coming thing and bid fair to earn large returns when the art of handling them is well understood. The best plan is to plant several kinds of fruit, so that all the eggs will not be in one basket.

COLONIES TO BE MADE.

Kern county is, of course, a new country. It remains largely to be developed. The land, the climate and the soil are there, but human industry can alone work out the problem of development. Enough has been done to show the capabilities of the soil. No portion of California will be more beautiful than this when the ranches which have formerly been farmed in thousands of acres shall have been divided and populated. Several attractive colonies are under way.

ONE IMPORTANT ADVANTAGE.

There is one very great advantage which every home-seeker ought to take into account in comparing Kern county with land propositions elsewhere. This is the fact that he is dealing with a company having abundant financial means to carry out its program of improvement. If it agrees to expend a certain amount of money in giving a new colony advantages superior to those enjoyed elsewhere, the thing will be done. The owners of the property are men of high repute and they have the money to carry out their ideas and agreements, no matter what happens. Many settlers have been deluded by promises that could not be fulfilled, simply because the people making them did not realize returns as quickly as expected and were therefore unable to do as they agreed. No such disappointment will ever arise in the case of the settlers in the Kern Delta colonies.


FREE EXCURSIONS TO CALIFORNIA.

Thousands of people are looking for homes in California. The Kern County Land Company has its offices and agents all over the East and in Europe. It offers free excursions to those who purchase lands. Parties who contemplate going to California should address S. W. FERGUSON, AGENT, BAKERSFIELD, CALIFORNIA.

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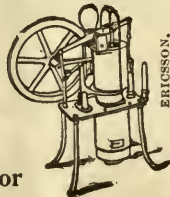
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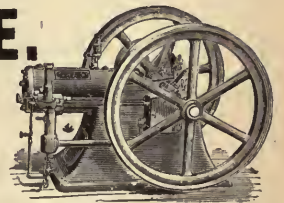
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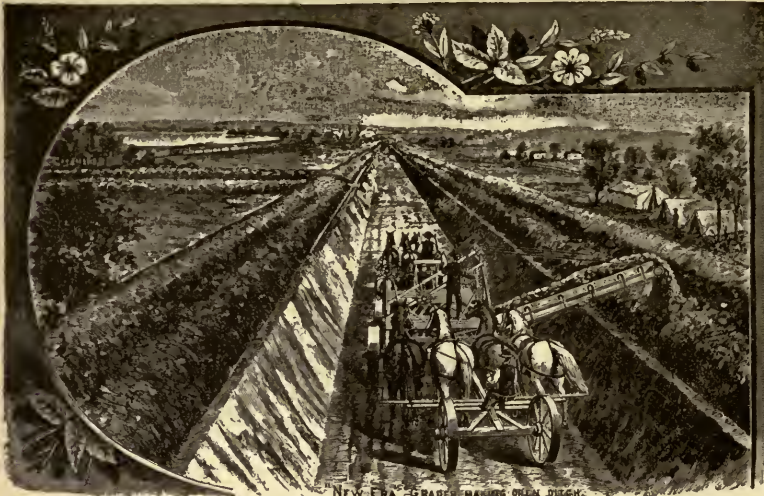
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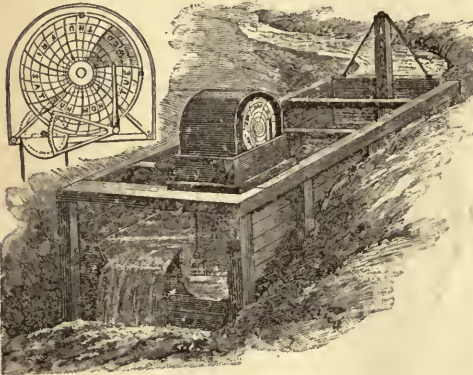
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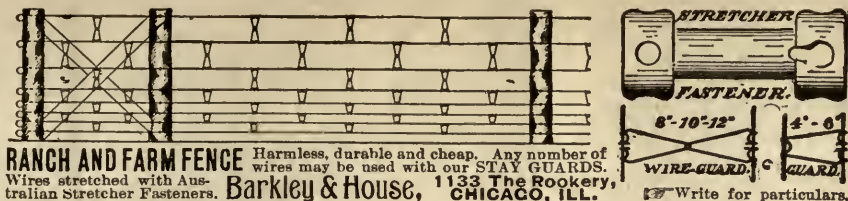
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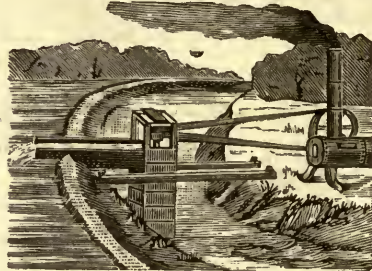
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THE IRRIGATION AGE.

VOL. VI.

CHICAGO, MAY, 1894.

No. 5.

THE PROGRESS OF WESTERN AMERICA.

Chicago and Western America. Chicago is rapidly becoming the commercial and financial metropolis of the new West—the focal point of the mighty energies which are about to create the institutions of the new empire. It is generally believed that Chicago has a quick eye for the recognition of its opportunities, and a strong and ready grasp to make the most of them. And yet it is plain that the average citizen of Chicago is not yet awake to the tremendous significance which Western America holds to the future of his city. On the contrary, certain influences in Chicago have sometimes seemed to be moved by an actually hostile disposition toward the only section of the United States which has the capacity to very largely increase the volume of its business and wealth. Some of its prominent daily newspapers have been needlessly and cruelly severe in their comments upon western aspirations. Particularly has this been true in their expressions about the silver movement. The people of the West are broad and tolerant in their views. They do not hold it to be a crime to believe in the single standard, and they freely concede that the great majority of single standard men are perfectly honest and sincere. But they claim equal honesty and sincerity for themselves. They are willing to be opposed and to have their arguments met by candid discussion, but they have never been able to understand why they should be met with statements that are about one part argument and nine parts abuse. If there is any place which can afford to be tolerant of western convictions, and to treat honest western opinion with a fair degree of respect, it is the city of Chicago, itself the grandest product of western energy and faith, and certain to be the largest single beneficiary of the further expansion of western States and Territories. On the subject of irrigation Chicago sentiment has been far more friendly. To-day its newspapers are not only fair but very sympathetic in their attitude toward the reclamation of arid lands and the promotion of worthy colonization enterprises. It may be predicted with confidence that within five years, and

possibly much less, the influential elements of Chicago will realize the full extent of the benefits which will accrue to their city from the prosperity of the



SENATOR ALLEN OF NEBRASKA.

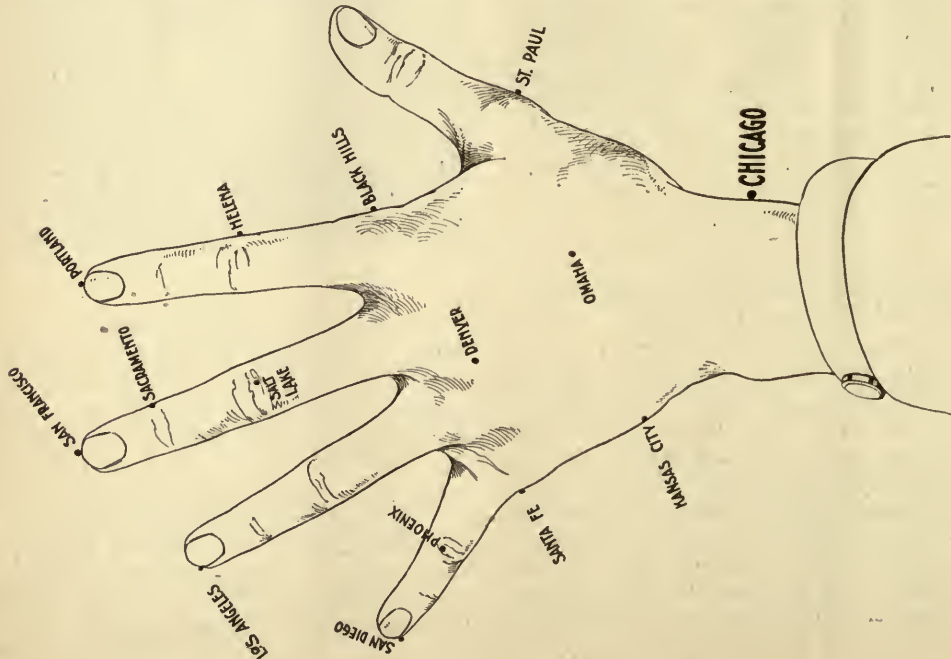
Author of the Bill Providing for an Irrigation Survey of the Semi-Arid Region.

wonderful country lying between the 100th meridian and the Pacific ocean. It is to Chicago that the people of this new empire will look for sympathy and support in all of its enterprises, and the powerful daily press of Chicago to which they will look for the vigorous championship of their economic and industrial policies. And from this prediction we do not exclude silver itself, for there are many indications that extreme views on both sides of this question are rapidly turning to a common center of reasonableness and conservatism.

How Chicago Will Be Benefited. To realize how Chicago will be benefited by the opening up of another rich and populous tributary section it is only necessary to recall the forces that created her. Some mighty impulse is responsible for the phenomenal growth of the great, puissant city at the head of Lake Michigan. What was it? It was the rapid settlement of the Mississippi valley and the Northwest. Chicago was made by a country which suddenly grew into an enormous producer of wheat and corn, cattle and hogs. Now, the seventeen States and Territories that remain to be developed are far superior in natural resources and in capacity to sustain a dense and money-making population. Their industries will be far more diversified and the average wealth of their people much larger. Their agricultural and horticultural output will ultimately exceed that of the prairie States which now furnish the bulk of Chicago's business, and to the products of agriculture there will be added the products of mines, factories and various other industries that naturally grow up where nature's bounty is so liberal and varied. While other distributing points to the westward of Chicago, such as Omaha, Kansas City, Denver, Salt Lake and large cities on the Pacific coast, will be benefited by the development of the Greater West, as they have already been, in a large sense this country will all be directly tributary to Chicago, which has ceased to be the capital of a section, and has become one of the capitals of the world. The growing cities to the west of her are really assistant Chicagos. They and their surrounding territories all drain into the ample lap of Chicago, and

the great transcontinental railways stretching out in all directions, but centering at the eastern terminus in the city by the lake, are the channels which bring the traffic and travel to the natural center, just as the snowflake falling on the highest mountain peak finds its way by means of rivulet and river down to the sea at last.

Prominent Citizens Take Interest. During the past six months Chicago has developed a very notable interest in this new field and become to a marked degree the center of its operations. It is now perfectly plain that Chicago is the starting point for the great currents of colonization which will populate irrigated lands. Every large enterprise of this sort now has its headquarters here. While branch offices are maintained at points in the East, in the South and in Europe, Chicago is the home office. Tons of advertising western matter are dumped into the Chicago post-office each week. Here the plans of campaign are formulated, and here excursions are organized. Even more significant than the rapid opening up of enterprises of this kind is the fact that many of the most prominent financiers of Chicago are studying the subject of irrigation and colonization in particular and the resources of western America in general. Marshall Field, Robert Lincoln, N. K. Fairbanks, Philip Armour, A. C. Bartlett, Otho Sprague and many others of equal prominence have been on tours of exploration through parts of the West during the past winter. Some of these gentlemen have a very clear idea of the advantages of irrigation, and it is quite within the possibilities that something more definite than this may be said concerning them before



CHICAGO'S HAND REACHES OUT OVER ARID AMERICA.

long. Among the prominent men who have already lent their names to irrigation and colonization projects in the last few weeks are B. M. Davies, A. F. Hatch, William H. Holcomb, manager of transportation at the World's Fair, Isaac M. Perry, of the Continental Bank, John R. Walsh, of the Chicago National Bank, James W. Scott, of the *Chicago Herald*, Lyman A. Walton, of the Equitable Trust Company. These facts, and many others that cannot properly be published at this time, indicate quite unmistakably that Chicago has taken hold of the task of making Arid America with her customary vim. And in this connection it is pleasant to recall that Chicago's motto is, "I WILL."

The West and the Nicaragua Canal. The people of the West do not generally appreciate what a vital interest they have in the speedy construction of the Nicaragua canal. Men who have studied this great enterprise in all its relations declare that no other factor can accomplish as much for the western half of the continent in fifty years as this great water-way through the isthmus would accomplish in ten years. A very prominent citizen of Chicago says: "It has taken the railroads and all other means of transportation nearly fifty years to put 2,500,000 people on the Pacific coast. The Nicaragua canal will put 10,000,000 people there in ten to twenty years." He believes that the cheap transportation for passengers and freight which would follow would result in the speedy settlement not only of the Pacific coast proper, but of all desirable territory west of the Rocky mountains. He believes it would also give a great impulse to the production of all that comes from the field, the orchard and the mine by opening new and promising markets. In other words, he believes the construction of the Nicaragua canal at this time would work a revolution in commerce and industry and do more than all the other factors combined to quicken the life of the far West. It may be that this gentleman's imagination is too fertile, but even if that be so the undisputed certainty of benefits to follow the completion of this enterprise are quite sufficient to unite the people in its support. The government should guarantee its securities and allow American capital and labor to complete it at once and American influence to rule it forever.

Railroads And Colonization In a recent communication to the Los Angeles *Times* that brilliant Californian, William H. Mills, accounted for the army of unemployed in the West, and for the general industrial depression of which they are a product, by calling attention to the cessation of railroad building. We have not the figures at hand, but he showed what enormous energies were utilized during the two



WILLIAM H. MILLS,

Land Commissioner, Southern Pacific Railroad.

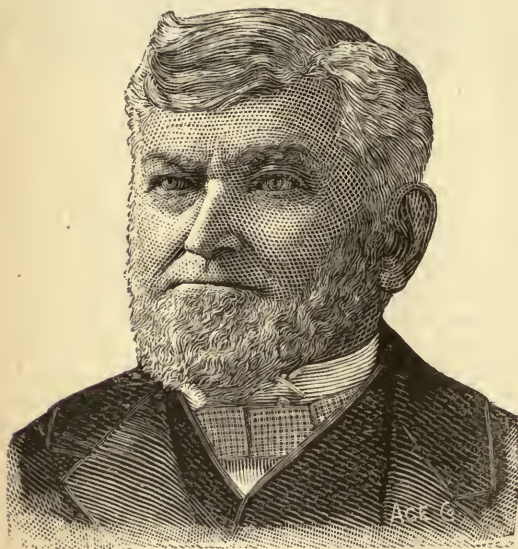
decades from 1870 to 1890 in this work. The number of miles of railroads constructed, and of men and capital employed in the work, presented an astounding aggregate. The almost total cessation of these tremendous activities would account in large measure for the idle people of to-day. It is interesting to reflect that nearly all the properties built during this period in the West are now in the hands of receivers.

The prevailing view of the railroad business is very dark, and yet those who know the capabilities of the country traversed by these railroad lines appreciate the fact that the difference between bankruptcy and a reasonable degree of prosperity is not very wide, after all. The fact is that money and labor have been almost recklessly employed in making means of transportation. How would it do to adopt the policy of making something to transport? A high official of the Union Pacific railroad recently said to the writer that he considered every new family upon his line to be worth, in passenger and freight traffic, counting what they shipped out and in, an average of \$250 a year. This railroad man has a very lively appreciation of the fact that a few tens of thousands of families, properly distributed, would transform the most hopeless railroad property of to-day into a solvent, profitable enterprise. The capital-

ization of the railroads of the United States is said to exceed ten billion dollars; a large proportion of it is represented by western properties. Every bondholder and stockholder in these railroads, whether his home be in Omaha, Boston or London, is vitally interested in the rapid progress of colonization throughout Arid America. It means the salvation of their investments.

Speaking of Mr. Mills, reminds us that **Mr. Mills' Big Land Sale.** this gentleman, in his capacity as land commissioner of the Southern Pacific railroad, has recently done a notable thing for the Crocker estate, for California, for a party of prominent Chicago gentlemen and for irrigation generally, by consummating one of the largest real estate transactions on record. He has sold to a syndicate in Chicago about 40,000 acres of irrigated land all at one stroke. Not only that, but also the water plant by which the lands are irrigated—a plant said to have cost over \$2,000,000, and claimed to be capable of

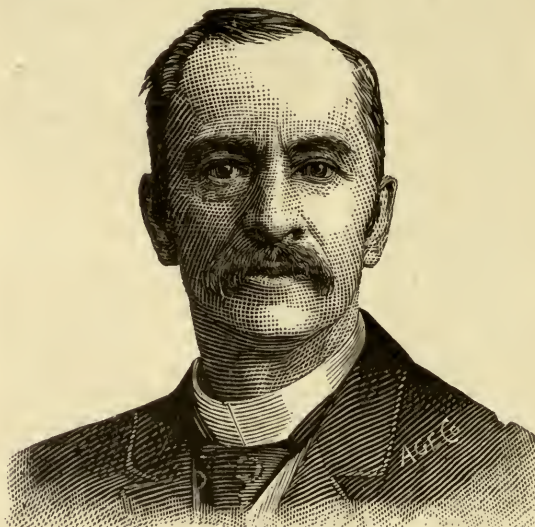
dustury the enlistment of some of the most influential men of Chicago in its support. The Merced properties will now become the scene of one of the grandest colonization enterprises on the continent. **THE AGE** heartily congratulates Mr. Mills upon his success in this affair.



WILFORD WOODRUFF.

President of the Mormon Church.

watering 600,000 acres. Still further, the town site of Merced and a large amount of miscellaneous property, the whole aggregating several millions in value. The transaction is a matter of far-reaching importance in several ways. To Merced and locality it means a splendid impulse for development; to the Southern Pacific railroad, the rapid increase of traffic in a rich and promising country; to the irrigation in-



BISHOP T. R. CUTLER,

Manager of the Utah Sugar Company.

The Replies to Major Powell's Articles. The two articles recently published in **THE IRRIGATION AGE** by Major Powell, dealing with the water supply and the arid public lands, have attracted wide attention and much newspaper comment. The series will be completed by a further paper on the duty of water, to be published in June or July, but we begin in this issue the presentation of the criticisms upon the important articles already published. In this number two gentlemen, who are good authorities on the subject of practical irrigation, enter a strong denial of Major Powell's statements, so far as they relate to the use of water in California and Arizona. In estimating the amount of water available and the amount of arid land it will reclaim, it is of the utmost importance to determine what is the practicable duty of a miner's inch or cubic foot—the common standards of measurement. Major Powell presented the deductions of science; Mr. Fitzsimmons and Mr. Hancock present the deductions of practical experience, and the difference in their conclusions is very wide. In the next issue **THE AGE** will present articles prepared by men of reputation, who dissent from the Major's statements in regard to the amount of irrigable public lands in the several States. When



A STRIKING COMPARISON BETWEEN THE PROMISED LAND OF CANAAN AND THE SALT LAKE VALLEY, ON THE LINE OF THE RIO GRANDE WESTERN RAILWAY.

all the evidence is in the editor of *THE AGE* will condense the statements contained in the original speech of Major Powell, his subsequent articles and the replies of his critics, and review the entire controversy. We would suggest that the questions raised by Major Powell be made the subject of a half day's discussion at the next Irrigation Congress, and that a special committee be appointed to prepare resolutions, defining the views of the men of the West on water supply and irrigable lands. These resolutions should be brief and lucid. They will be accepted by investors and settlers as authoritative, and thus we shall reach final conclusions about a

subject that has disturbed the irrigation world from the moment Major Powell's startling views were proclaimed. It will have taken time to dispose of the matter in this thorough and conscientious way, but the results will be worth something, and the future is long.

Canaan and Deseret. The accompanying map of Canaan

and the Salt Lake valley strikingly exhibits the topographical similarity between the Promised Land of the Bible times and the Promised Land to which Brigham Young led the Mormon pioneers of 1847. In both localities a River Jordan connects a body of fresh water with a Dead sea, and the surrounding mountain landscape is almost the same in both cases. How much this strange likeness may have appealed to the imagination of Latter-day Saints it is not easy to say, but it is by no means difficult to understand how even a sentiment might take very firm hold of a people's mind, especially a people having

just such an historical environment as the Mormons.

In this connection we present a portrait of the memorable Wilford Woodruff, who in his eighty-fifth year is still the active head of the Church of Jesus Christ of Latter-day Saints. He has lived nearly fifty years of his life on a twenty-acre irrigated farm and his experience has fully illustrated the soundness of Brigham Young's industrial policy alluded to elsewhere in this issue of *THE AGE*. Bishop Thomas R. Cutler, of whom a portrait is also published, is the manager of the sugar factory referred to in another place in connection with a discussion of irrigated sugar beets.



CASTLE GATE, SHOWING CHARACTERISTIC UTAH SCENERY, ON THE LINE OF THE RIO GRANDE WESTERN RAILROAD.

**The Problem
in the
Great Plains**

There is no mistaking the character of the irrigation movement now under way in the Great Plains region. They are in downright earnest this time and will certainly achieve splendid results. The inventors of rain-making machinery will apply this year in vain. We believe that even a season of unusual rainfall would be powerless to seriously injure the present movement. The demand for national appropriations to be expended in this section is now strong and insistent. We think the people of other localities are quite willing to see the semi-arid region favored in this matter. The arid public domain west of the Rocky mountains cries aloud for reclamation, but it is not occupied by people who were duped into settling there under false representations and who are suffering for immediate relief. The semi-arid regions have a population, and the common instinct of humanity demands that the government which received their money for lands practically worthless for agriculture without irrigation should spend some of that money in pointing out the methods by which they can help themselves. No effort should be spared to bring about this result. Such opposition as there is to this course arises from unworthy sectional prejudice and contemptible personal malice. Neither of these motives are entitled to any respect at the hands of an enlightened Congress.

Pass the Allen Bill. Senator Allen of Nebraska has introduced a very simple measure to provide "For an Irrigation Survey of the Great Plains and Semi-Arid Lands of the United States." The full text of the bill is as follows:

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That from and after the passage and approval of this Act it shall be the duty of the Secretary of the Interior to cause an irrigation survey to be made of the great plains and semi-arid lands of the United States which are made non-productive by reason of too small an amount of rainfall under such rules and regulations as he may prescribe. Accurate field notes of such survey, maps, and other data shall be made and preserved, and when said survey is complete a detailed report of the same, in writing, with said accompanying data, shall be made to Congress.

SEC. 2. That to carrying into execution the purposes of this Act the sum of five hundred thousand dollars, or so much thereof as may be necessary, is hereby appropriated, out of any money in the Treasury not otherwise appropriated, to be expended under the direction of the Secretary of the Interior.

The States Should Help Themselves. Colonel Chas. G. Stevenson, the veteran engineer, delivered an eminently sensible speech before the Committee on Irrigation of the Utah Legislature recently. He urged them to pass a bill providing for the appointment of a commission of inquiry and for stringent laws protecting the water supply and defining the conditions under which ditches can be built. Utah's entire

industrial system is based on its irrigation development, and its hope of further growth rests on the same foundation. Utah is older than any other American community in modern irrigation practice and yet, as Colonel Stevenson pointed out, she has no official knowledge of the extent of her water supply, nor even of the appropriations that have been made,



COL. CHAS. G. STEVENSON,
Of Utah.

except as locally recorded. If there is one department that is essential in Utah's scheme of government it is a capable irrigation bureau. And this is true of all the States in the arid region. They should not rest satisfied with lax laws and administration. Irrigation is for them the thing of present and of future importance. They should depend less upon the general government and more upon themselves in seeking to develop this interest. Utah and the rest should have vigorous and comprehensive irrigation and colonization policies. It is an interest which cannot be safely left to unrestricted private enterprise. Utah owes the large measure of success it has achieved without adequate laws and proper public administration to the strong secular policy of the Mormon church, but she has lived beyond that period. We note with pleasure that Colonel Stevenson, in common with other local authorities, refutes the charge that she has no more surplus water or irrigable public lands

A Sensible Editorial Pilgrimage. The accumulating evidence of deep and growing interest in irrigation and its kindred industries is gratifying beyond expression to the men who have carried the banner through skepticism and indifference to the sure ground of enduring popularity. E. V. Swalley, the



S. B. ROBBINS.

Nominated for Montana's Member of the National Committee.

energetic and brilliant editor of the *Northwestern Magazine*, left St. Paul April 18th with a party of editors who can, if they will, put the irrigation idea several years forward. They will inspect the reclaimed lands of Montana, Washington, Oregon and Idaho. The party included the following: David Woodward, of Chicago, editor of the *Farmer's Voice*; James Strong Judd, of the same city, editor of the *Orange Judd Farmer*; C. H. Coleman, of St. Louis, editor of the *Rural World*; Mr. Connor, of Indianapolis, editor of the *Indiana Farmer*; Mr. Lawrence, of Cleveland, editor of the *Ohio Farmer*; Charles H. Nixon will represent the Chicago *Inter Ocean*.

The Carey Bill It is persistently reported from Washington that Senator Carey of Wyoming **Obnoxious.** will succeed in passing his Limited Land Cession bill during the present Congress. Nevertheless, THE IRRIGATION AGE does not hesitate to predict that he will not do so. The men who are directing the irrigation movement, and the masses who stand behind them, do not want that bill passed at present. It is an imperfect and abortive measure and represents neither one side nor the other of the old controversy between those who favored and those

who opposed the absolute control of the public lands by the several states. The introduction of the bill at this time and the attempt to crowd it through Congress in the manner that is being done is little less than an insult to the organized irrigation movement of the West. The measure has not been publicly attacked by those who are officially responsible for the acts of the national organization, but it must not be thought for that reason that they have neglected it. They have taken the precaution to study the situation and to put up the bars so far as it seems necessary at this time. They are advised from the best sources that the measure has no real chance of passing at this session. If it becomes seriously prominent active and effective measures will be taken to interpose the influence of the official organization. In seventeen States and Territories commissioners are now at work preparing a thorough and exhaustive statement of the demands of the people of their respective localities in the matter of national and State irrigation policies. These reports will be presented to the next Irrigation Congress, to be held in September. They will be carefully considered and from the facts and conditions they present it is probable that there will be formulated a national irrigation policy on which the people of the West will



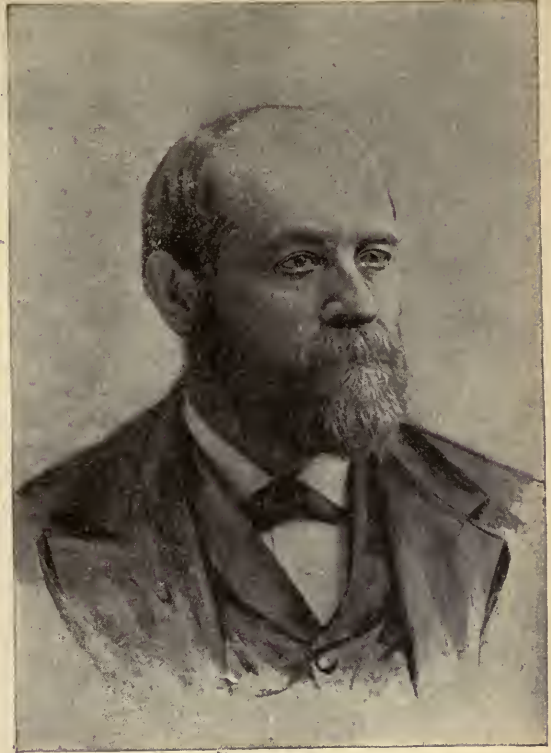
HERBERT P. ROLFE.

A Prominent Irrigation Leader of Montana.

enthusiastically unite. Senator Carey has proceeded in contempt of the only organized irrigation sentiment which is recognized by the western people. But he will be beaten. His motives may be good, but his judgment and his manners are very bad indeed. He will know more one of these days. It is to be hoped that Wyoming will lose no time in restoring Francis E. Warren to the United States Senate. And in saying this we do not know whether Governor Warren favors or opposes the Carey bill in its present shape. But we do know that he would have taken no important action without the widest consultation with the friends of irrigation, from Kansas to California.

The leading article in this number of *"The Republic of THE AGE deals with what we conceive Irrigation."* to be the most important consideration involved in the reclamation of the arid and semi-arid areas of the United States. It is the problem of organizing prosperity for the masses by illustrating the means by which they can acquire homes and become absolutely self-sustaining through the systematic production of what they consume. This is the first principle. The second is the approach to a reasonable degree of equality among men, which is to be realized in communities of small farms, where there can be no very rich and should be no very poor; but, in place of both, a fair average of profits and enjoyments for all. There is nothing of communism in this idea, since each individual will be left to work out his own problems, save that he may work, if he choose, with the brains and experience of the most expert minds, who will have formulated plans for his guidance—plans open to the study and use of all colonists on irrigated lands. The third principle will be the introduction of features intended to foster the highest industrial, social and civic institutions, to the end that the civilization of the new time and the new country may be the best the world has seen. We have been gradually approaching something of this kind for years by a process of natural evolution. The time seems to have arrived when the realization of these ideas on a large scale can be enormously hastened by the coöperation of the leading minds of the irrigation world and of prominent friends of progress in the East. The publication of the present article is intended as the first step in a campaign that should not end until the making of model colonies is seriously begun and the tide of settlement flowing unmistakably to the new West. We invite editorial comment and personal correspondence on the subject.

The portrait of Richard P. Bland in these pages may well remind the reader of the intimate relation existing between the irrigated farm in the valley and the



RICHARD P. BLAND.

Representative from Missouri.

home market furnished by the mine on the mountain side. Congressman Bland is, perhaps, the best-respected man in public life of the West by western men as a whole. His advocacy of silver through good and ill repute has endeared him to those who sincerely believe that his cause involves human liberty and fidelity to the constitution and the traditions of our country. Right or wrong, Richard P. Bland speaks with the voice and conscience of the statesman. His course is not dictated by mine owning constituents or peculiarly local interests. The mining industry of the West is working its way out of the slough of despond. An important new gold camp is the Cochiti district in the heart of New Mexico. All over the arid West men are busy with mining operations. As to the silver agitation, the men of the West are watching events with keen interest. They see in the world-wide depression, unrelieved by the repeal of the Sherman law, in the tramp of industrial armies toward Washington, in the growing clamor for radical legislation, the falling of that shadow which they have long feared and foretold. There is no need now for silver conventions, or obstructive measures in Congress. Commerce and industry, without regard

to nationality and section, hold up their hands in mute appeal to the makers of financial policies. And the great, silent, hopeful, generous West—conscious of its enormous ability to sustain population and create wealth—awaits with keen interest the outcome of events.

Hopeful Nevada Men. A representative of THE IRRIGATION AGE recently spent a few days at Carson, Nevada, and writes enthusiastically of the capabilities and attractions of that much-abused and little-understood State of the Sierras. He insists that it has the climate best suited to the Anglo-Saxon race, that it has the soil essential for diversified production and that its water supply is such as to offer remarkable inducements for irrigation enterprise. And above all, he asserts that Nevada has *the men* necessary to make a State. He names John E. Jones of the National Committee, Governor Colcord, A. M. Gerrington, Messrs. Taylor, Stewart, Rule and Fulton of Reno, the Newlands and many others, who are live champions of their State. The Nevada exhibit at the World's Fair, quite fully described in these pages last September, was a splendid revelation of the natural endowments and industrial possibilities of this State. That it has a great future in store no thoughtful man can dispute, but it is not strange that the people are somewhat impatient for that future to begin to materialize. Certainly Nevada ought to be able to obtain her share of the benefits certain to follow the present aroused interest in colonization and irrigation development.

Welcome Georgia and Florida. During the past month the national organization of the irrigation movement has received applications from citizens of the States of Georgia and Florida, for representation on the National Committee as a preliminary to the presentation of their irrigation possibilities at the next Irrigation Congress. And, of course, the answer has been, "Welcome Georgia! Welcome Florida!" W. G. Whidby of Atlanta, has been named as the member for Georgia, and W. C. Kingsbury of Winter Park, member for Florida. Both of these southern States will be heard at the next congress, and it is even possible that the commission may render full reports upon their irrigation interests. We predict that within ten years, and we believe half that time, every State in the Union will have irrigation before it as a local problem, and that gradually we shall approach that happy State of civilization, based on small farms, sure crops, diversified production,

and their social and economic concomitants, that the whole country would have realized decades since if the Pilgrims Fathers had landed at San Diego, rather than at Plymouth.

Where is a Bank Wanted? A Connecticut subscriber of THE AGE writes to inquire as follows: "Do you know of a good location for a bank? Would like to get in an irrigated section having good prospects of development, and in a town where a good line of depositors could be secured." This eastern man appreciates the solidity of a country whose crops are insured by the ditch and which will enjoy part of the enduring prosperity certain to come to Arid America. We have no doubt there are many places where a new bank is needed that meet the requirements stated. Applications addressed to THE IRRIGATION AGE, Chicago, will be promptly forwarded.

"Tom" Reed Beholds the Dawn. No utterance of an eastern public man in years has given the friends of western America such satisfaction as the extract from the Pittsburg speech of big "Tom" Reed, of Maine, quoted on page 195 of this number of THE AGE. It is particularly pleasing because of the way in which it was said. It was not a studied speech, and formed only an incidental paragraph in the course of impromptu remarks. It is thus relieved of all color of presidential posing which it might have had if put forth as a conspicuous feature of a set speech addressed to western men. It may be accepted as evidence that one of the strongest of modern American statesmen—a New Englander, with a marked nasal twang at that, has beheld the tints of dawn for Arid America. We cannot be far, then, from general appreciation of the true significance of our new institutions and from that enthusiastic coöperation of our countrymen which means the furnishing of money and men, and plenty of them. "Tom" Reed may yet irrigate his presidential boom with the votes of western men.

W. H. Rowe Succeeds Gov. Thomas Ex-Governor Thomas, of Utah, advises Vice-Chairman Gregory, of the National Committee, that he will not accept the Utah membership of that body. Mr. William H. Rowe, of Salt Lake City, was promptly named to fill the vacancy and he will at once organize the long-neglected work in that important field. The report of the Irrigation Commissioner of Utah will command wide attention because of the successful development of the industry along peculiar lines in that locality.

THE REPUBLIC OF IRRIGATION.

WITH OPEN LETTERS TO SEVERAL DISTINGUISHED AMERICANS.

BY WILLIAM E. SMYTHE.

BEHIND the creative energies of the new generation of western Americans stands the conception of a noble civilization. The time seems to have come when the great message may be profitably delivered to the country and to the world. Silently, but swiftly and surely, in seventeen States and Territories, men are laying broad and deep the foundations of institutions. The results of their labor and faith will be calculated, not merely by miles of ditches built and acres of soil reclaimed, but in social and economic developments more precious to humanity than material assets.

The representatives of the irrigation movement, assembled in their international congress at Los Angeles in October, 1893, declared that a national irrigation policy meant "not only the conquest of a new agricultural empire and a tremendous contribution to the national wealth of the future, but involved the development of new forms of civilization and will give new life to popular institutions." This declaration was merely a generalization, but it rested upon convictions that are real and upon ideas that are workable in a practical sense.

A NEW OUTLET FOR HUMAN ENERGIES.

Human genius demands a new field for conquest. The conditions of prosperous activity in all settled communities, alike in the new world and in the old, appear to have been outgrown. For the past twenty years the current of population has set steadily and strongly in the direction of great cities. Manufacturing industries have enormously expanded and agriculture and horticulture have exhibited the same tendency to specialism that has marked the recent development of nearly all trades and professions. We are in the midst of a world-wide depression that will be historic. Industries are in total or partial idleness. Millions of people who have formerly added something each Saturday night to their savings accounts are drawing to-day upon their principal. Tens of thousands are menaced by real hardship, and thousands of desperate men are marching in the direction of the national capital to demand relief. Whatever may be the cause and whatever the remedy, the condition is not in dispute. Industry and commerce show an unhealthy pulse.

ARID AMERICA'S OPPORTUNITY.

It almost seems as if there were too many people in this world—as if there were more mouths to feed

than food with which to satisfy them. Whether we have reached the crisis of our social and industrial woes, or whether events more dangerous than any yet encountered are still before us, no one can tell. But it seems plain that the world demands some new field for the profitable employment of human energies, some field which will not only absorb labor, but reward it, at least, with the means of living. In this situation, so full of evil promise to many students of events, Arid America beholds her opportunity. Her friends have long seen that the time must come when she would present the one broad field remaining on this continent for agricultural and industrial expansion, but they expected that the realization of this condition would come gradually and that it would not be very marked for some years. It seems, however, to be close at hand. In this springtime of 1894 the first light of a new morning appears to be breaking for Arid America. It is in her valleys and upon her plains, guarded and shadowed by her eternal mountains, that the problem of how to find the highest average prosperity for the common people may be solved. The case needs but able and persistent presentation to take it home to a world that is sorely in need of such a solution.

THE THEATRE OF FUTURE EVENTS.

The drama of the future will be enacted in Western America. Its stage will be half a continent. The period of greatest development will be the twentieth century. And those who have most carefully studied the conditions to be presented by the new country, and the forces that will rule the new time, religiously believe that there and then civilization will score its highest triumphs. It is unnecessary to describe here the wealth and variety of the resources, soil, and climate of the States and Territories of the West, since every issue of THE IRRIGATION AGE is a reflection of these things. But it may be said that in all parts of this broad empire the people are alive to their responsibilities, and realize the importance of the things which are being borne to them on the swift tide of time. Along the eastern boundary of the arid region—in the Dakotas, in Nebraska, in Kansas, in Oklahoma and in Texas—irrigation is beginning to receive the profound attention of the people. The same is true along the western boundary, in California, in Oregon, and in Washington. So also in that wonderful region which lies

between the Rocky mountains and the Sierras, bounded on the north by Canada and on the south by Mexico. Montana, Idaho, Utah, Nevada, Wyoming, New Mexico and Arizona—each and all of these mighty commonwealths of the future are wide awake at last to the tremendous significance which irrigation holds to the evolution of their industrial, social and civic life.

THE IMPERIAL AMERICAN.

Before proceeding to a statement of the practical side of the subject, let me say a word about the characteristics of the western man. Of all Americans, he is the one imperial American. While he labors incessantly in the making of cities and States, he is thinking of his country's glory and his country's greatness. The citizen of New England, like the citizen of the South, is full of the pride of his provincial history. He has much to be proud of along this line, and very naturally it colors his thought and conviction. The citizenship of the West is founded on New England and southern stock, and its aspirations are curiously and grandly blended in a desire to make the western States and Territories the greatest and best half of the American Union. The progress of the West, as the citizens of that section see it, is inseparably associated with the progress of the United States. Men go out into a western wilderness from ancestral homes in eastern and southern States and foreign countries, and resolutely face the hardships of pioneer life. They subdue Indians and wild animals, divert rivers, conquer deserts, open mines, construct railroads and build towns, and then they return and proudly lay a new American State at the feet of the mother nation. This they have done in the spirit of imperialists, and in the same spirit they continue to urge forward the development of the Territories they have acquired.

II.—ARID AMERICA'S CLAIM ON MANKIND.

The number of physicians who profess to have sure remedies for the present ills of the world is very great, but the men of the West do not hesitate to make their appeal to the great good sense of the people on that account. They know the potentialities of the arid region for the production of average prosperity. They appreciate the tremendous fertility of the irrigation idea. Their dependence is not upon legislation, except in the most incidental way, but upon brains and muscle and human sympathies. These are elements not peculiar to any race or age, and elements of which a supply is not lacking, even in these hard times.

THE DESIRE FOR INDEPENDENCE.

The first desire of man is to be independent. This is one of the precious things for which men have struggled through the centuries. True independence is not merely immunity from the exactions of church and state. For more than a hundred years this republic has offered an asylum for those oppressed by pope and king, and yet we are very far from a realization of that quality of independence dearest to the human heart. This is security in the support of one's family. The sharp and sudden business convulsion of last summer, followed by the long period of depression, again taught the world that no man is independent who does not live under his own roof, and support his family from the products of his own acres. In the best sense no man is independent who works for another. He cannot tell at what moment a threat of tariff-tinkering at Washington, the cessation of silver coinage in India, or the collapse of a boom in Argentina or Australia, may render his fancied security in employment a precarious dependence for the support of his family.

THE FAILURE OF AGRICULTURE.

It will instantly occur to the reader of these pages that our agricultural population is nearly, if not quite, as unprosperous to-day as the army of laborers in great cities and manufacturing towns. There is much truth in this, and to say that the average farmer is barely existing is to fail of a complete statement of the case. He is not only unprosperous, but unhappy as well. His children have been leaving the farm to swell the already superfluous population of great cities. His wife has lived in drudgery on the lonely expanses of the big farm. She has been denied the comfort of near neighbors and nearly all the advantages of social, literary and religious institutions. The universal unrest is nowhere more marked than on the farm. Indeed, the farmers of the West and South have been foremost in forsaking old political idols to join in new movements, tending they knew not whither, in the vague hope of finding remedies for existing evils. If the men of Arid America offered no remedy except farming in the sense that farming is now known, they would not expect their prescription to be enthusiastically received, or cheerfully taken.

THE PHILOSOPHY OF THE SMALL FARM.

Arid America does indeed intend to turn the current back to the soil and to revive the charm of country life, but the agricultural industry of the new empire and the new century will have little in common with the agricultural industry as it exists to-day east of the imaginary line which divides the humid area of the United States from the semi-arid and arid regions. The men of the irrigation congress prom-

ised "new forms of civilization" and "new life to popular institutions." The foundation of their philosophy of great average prosperity for common people will be the small farm, varying in different localities from ten acres to forty acres. Irrigation will make its crops absolutely sure and enable its proprietor to cultivate it intensely and scientifically, to the end that each acre shall produce the largest possible crop of the best possible quality. We do not yet know precisely what this means, since progress is constant, but we do know that the small farm, intelligently managed, under these conditions will produce many times as much in pecuniary value, acre for acre, as land in the most favored sections of the rain belt.

PRODUCING WHAT THE FAMILY CONSUMES.

But we have not yet stated the fundamental tenet of the new philosophy. It is this: That each family shall produce, by a system of diversified farming, as nearly as possible everything it consumes. During the past ten years the tendency has been very much in the opposite direction. We have the Tobacco Belt of Virginia, the Cotton Belt of the Gulf States, the Wheat Belt of Kansas, Minnesota and the Dakotas, the Corn Belt of Nebraska. On the Pacific coast we have the prune district, the raisin district and the orange district. Now, we can have too many prunes, raisins and oranges, too much wheat, corn and cotton, but we cannot have too many people absolutely self-supporting and hence beyond the reach of industrial calamity. We shall always have periods of financial distress. The prices of the great staples will sometimes fall below the cost of production. Manufacturing communities will sometimes be idle. The ships of commerce will sometimes lie becalmed on the sea of world-wide depression. But for the man who lives under his own roof, producing systematically from his own land what his family consumes, there can be no panic, no calamity, no hardship, no despair. He and his will eat three meals each day and feed "industrial armies" at their door.

THE ONE-CROP ERROR IN THE WEST.

It is not claimed that this ideal industrial condition has yet been fully realized, even in the arid region. In a recent speech a resident of the San Joaquin valley of California made these truthful observations:

"We let our timber rot and buy fencing. We throw away our ashes and grease and buy soap. We raise dogs and buy hogs. We let our manure go to waste and buy guano. We grow weeds and buy vegetables and brooms. We catch five-cent fish with a four-dollar rod. We build school houses and send our children off to be educated. And, lastly, we send our boys out with a forty-dollar gun and a ten-dollar dog to hunt for ten-cent birds."

Another intelligent western man recently stated in an interview: "It seems a funny thing that thousands of ranchers in this western country should buy condensed milk, canned fruits and vegetables, and stranger still that they must buy the common fruits and vegetables of the country from their wiser brothers, or go without them. It is worse than funny or strange, when not only the stockman from the ranges, but also the wheat-growers and fruit-growers in the fertile valleys, send their dollars by hundreds and thousands two thousand miles away for hams and bacon, butter and eggs, when all may be produced of the highest quality on their own places. Southern planters have told me that their worst troubles came not from the war in the sixties, but from the exclusive cotton planting that followed after the war, induced by the unnaturally high prices of that period."

There is great truth in all this, but only a slight beginning has been made in the settlement of the arid region. The high prices formerly obtained for cattle and sheep in some localities, and for fruit in others, did lead farmers in the arid region into the wrong path. But they have not gone far and, what is much more important, ninety-nine one-hundredths of the population of Arid America has still to make its start. And a very large proportion of the new population will start right.

BRIGHAM YOUNG'S SUCCESSFUL POLICY.

Against the folly and error of the one-crop country, east and west, there is one bright example of success through diversified production which cannot be too often recalled. It is the example of the builders of Utah. They went to that beautiful land a little less than fifty years ago as a band of fugitives. They were cut off by high mountain ranges and great distances, then untraversed by the iron horse, from civilization. They had no assets, save the brain of a masterful leader of men. Whatever may be thought of the religious doctrines then sincerely held and practiced by the Mormon people, Brigham Young was a very great man. He was animated by the spirit of the empire-builder. In all-round practical sense and capacity to do a great many things well, he much resembled Benjamin Franklin. Finding himself in what appeared to be a hopeless desert, he formulated an industrial system to which he adhered to the day of his death. So perfectly was he able to enforce it that every Mormon farmer and artisan labored with the brain of Brigham Young. He said the farm unit should be twenty acres. He said each family should produce first of all what it consumed and then a surplus exchangeable for some other form of property. The surrounding mountains were bursting with mineral wealth, but he said it should lie there untouched, because of all things he abhorred the spirit of speculation. He had founded his state upon

industrialism. The world knows the result. Each farm of twenty acres supported its owner and in a very few years the people became absolutely free in an industrial sense. Not only did the system produce enough to satisfy all the wants of the people, but it produced a surplus capital for banks, factories and stores. Not only that, but a surplus of many millions for temples and missionaries. There are no Mormon recruits in the "industrial army" of to-day, and there never will be.

GREELEY THE SAME.

Another example is the colony founded in Colorado by Horace Greeley and bearing his honored name. There the farm unit is eighty acres, but the same system of diversified production is followed. Irrigation as a science has been reduced to a fine point and the Greeley potato is as famous as the melon of Ispahan. Last summer newspaper readers learned daily that in Colorado mines were stopping, railroads failing, banks toppling and mercantile houses closing their doors. The State seemed to be hurrying to disaster. In those fateful summer days Greeley was an oasis of prosperity in a desert of despair.

CONDITIONS OF EQUALITY.

Independence is not the only thing which humanity has sought with tireless zeal through the centuries. The counterpart of independence is equality among men. The founders of this republic, in pure good faith, be it said, promised it to the ear, but their descendants have broken it to the hope. In theory there are no class distinctions in this country. In practice the class distinctions are almost as deeply marked as in Europe, and year by year they become more startlingly distinct. Human equality in the sense that all shall be upon the same level of intelligence and financial independence is impossible, but the nearest possible approach to practicable equality of burdens, of opportunities, of possessions, of enjoyments will be realized in Arid America and in the twentieth century.

The valleys of the arid region will be carved up into small farms. Probably the average unit will be twenty acres. No man will ever accumulate a great fortune upon twenty acres, but no man who heeds the Divine injunction, "By the sweat of thy brow shalt thou eat bread," will ever be poor on twenty acres of irrigated land, scientifically cultivated. The reclaimed areas will be densely populated. The result will be near neighbors and social, educational and religious advantages within the reach of all. The farmers of Arid America will enjoy the sweet, pure life of the country at its best and they will also realize the most desirable advantages of neighborhood association. This means a revolution in country life. It will be more like the ideal society of the ancient

Greeks than like the dreary lonesome life of the farming population in the older parts of the United States.

IRRIGATION WILL HAVE A PARTNER.

In the development of the new conditions irrigation will not be the only force. It will have a partner. Its name is Electricity. We are just on the borderland of an undiscovered country. Electricity will soon be applied to manifold domestic and industrial uses wherever it can be cheaply generated. Study the typography of Western America and you will see how God piled up the mountain ranges so that they would catch and hold the winter snows that the summer fields might be watered. Hidden in the bosoms of these mighty mountains are thousands of natural water powers. It can almost be said that where there is water for irrigation, there is water for power. The diversified farm, and the home warmed and lighted by electricity, will be the twin offspring resulting from the marriage of those stalwart parents, Irrigation and Electricity. We shall have in Arid America the most rapid and universal development of advanced electrical conditions.

III.—MAKING THE REPUBLIC OF IRRIGATION.

I believe, then, that the distinctive achievement of the new century will be the evolution of the Republic of Irrigation. The scene of this development will be half a continent of almost virgin soil. Its guiding spirits will be a race of optimistic Americans, dealing with great problems in the spirit of imperialists, and profoundly believing in the future progress of the race. Realizing that they are the heirs of the ages, they expect to profit by the world's enlightening experience in erecting their own institutions. In availing themselves of this experience, they will not be handicapped by awkward traditions and deep-rooted evils. This is a very great advantage. Everybody knows, for example, that the cable roads and gas monopolies of Chicago represent an enormous amount of fictitious capital on which the public is unjustly compelled to pay dividends, but they are established institutions, representing vested interests which society hesitates to disturb. But Western America is for the most part a virgin field. Its institutions are to be created. Where civilization has yet to lay its foundation walls, civilization need not erect its cornice of repulsive wrong. Without injustice to existing interests, the men of the new West may evolve purer institutions in that wide domain that is still largely the public estate of the American people.

THE FOUNDATION.

But the foundations of the Republic of Irrigation will be independence and equality—*independence*

through a system of production which furnishes what each family consumes, equality by reason of close settlement of communities on small farms. Around these two fundamental principles will be grouped all the advantages of a twentieth century civilization. The loneliness of country life will be banished forever. The really desirable features of town life will be carried to the country, and the charms of country life will be carried to the town. The most inspiring and satisfying features of both will be perfectly blended in a new order of civic life, underlaid by a foundation of certain and enduring industrial prosperity.

THIS IS THE WESTERN ASPIRATION.

These are the convictions and aspirations of the new generation of western Americans who to-day, in seventeen western States—in a thousand valleys of Arid America—are waging a war of conquest upon the desert. This is what they mean when they say, We will evolve new forms of civilization! We will give new life to popular institutions! They are more than imperialists, for their imagination grasps new possessions, not only for their country, but for their race and kind. We have been approaching by slow and painful steps the realization of this dream, where men shall be free and equal and prosperous beyond the power of legislation and greed to injure. We have our Greeley, our Riverside, our Valley of the Great Salt Lake, but everywhere, from the Republican river in Nebraska to the Yakima in Washington, from Canada to Mexico, we want to hasten the coming of population and the making of prosperous communities.

IV.—PRACTICAL METHODS OF PROGRESS.

It seems to me that events world-wide in their significance have suddenly opened the way for a more rapid progress than we have dreamed of. All the old States and all the old countries are to-day in need of an outlet for surplus population. In Arid America we have the land, the water and the plan of self-sustaining human industry which will do more than all the tariff policies and financial remedies to restore general prosperity and relieve the pressure of hard times. If we can promise no more to each family than simply that we will show them where they can own a home, and sustain themselves from the product of their own soil, we promise them more than the most confident reformer in Congress or Parliament has dared to suggest. That this promise can be fulfilled is demonstrable. We can do more. In ordinary years the little irrigated farm will not only sustain the family, but furnish them with a surplus the proceeds of

which will go to improve their conditions or provide a competence for old age. But first of all the great heart of the world must be reached, and then the thoughtful leaders of public sentiment must unite in formulating plans for model communities. I have some practical ideas to suggest.

A LEAGUE OF WESTERN BRAINS.

If the civilization of the future exists anywhere it is in the brain and heart of those who best know and love Arid America and its institutions. Some of this class of men are prominent in public life, but many of them are humble men living on irrigated farms. I have already submitted to several distinguished men, through private correspondence, plans looking to the development of model colonies which may illustrate the highest possibilities of irrigation, applied to diversified agriculture, and of electricity, applied to domestic and industrial uses. The replies so far received are extremely favorable. At the next session of the National Irrigation Congress I propose to call together the most influential and thoughtful men of the various States and Territories and invite them to join me in formulating plans for these model communities. We will map out a number of schemes of diversified farming, applicable to different localities, taking into consideration, first of all, the great principle of self-sustenance, and, secondly, the production of the best surplus for market. We will take up the question of the farm unit for the different localities, forms of administration for the colonies, plans for economical and attractive architecture, and the best manner of training settlers in methods of scientific and intensive cultivation under irrigation. I will undertake to marshal the brains and the heart of Arid America in order to hasten, by downright practical means, the making of the new civilization. I will leave it to be determined how the results of these labors shall be applied, whether by giving them common publicity, or by the creation of model colonies under a business administration to be hereafter developed.

FARMERS ASKED TO ADVISE.

But equally important is it to have the counsel of those men, unknown to public life but schooled in the practical problem of irrigation farming, and deeply interested in the welfare of their country and race. I would like to learn from men of practical experience just how near it is possible to approach the ideal I have set forth, the production of what each family consumes. I would like to have this question carefully studied, as it presents itself on the plains of the semi-arid region, in the valleys of the inter-mountain country, in eastern Washington and Oregon, and in the semi-tropic belt of California and Arizona.

Here are four divisions of the arid region, presenting different phases of the problem:

First—Kansas, Nebraska, North Dakota, South Dakota, eastern Colorado, Wyoming.

Second—western Colorado, New Mexico, Utah, Nevada, Idaho, Montana.

Third—eastern Washington and Oregon.

Fourth—California and Arizona.

A LIBRARY FOR THE BEST PLAN.

I will be glad to correspond with farmers in each of these localities on the subject of diversified agriculture, and to the four parties who will furnish me with the best list of products that can be grown in these localities, taking into account the sustenance of a family in comfort, and further, the production of a surplus product for market, I will present a well selected library of books on agriculture, consisting of twenty-five volumes. In other words, I will give four such libraries, one for each district. These lists should be received at Chicago not later than September 1st, and the decision will be announced in *THE IRRIGATION AGE* for October and the library delivered at that time. I would also like to have my correspondents discuss the other features of attractive model colonies, such as the size of farms, character of towns, types of architecture and methods of instruction for new colonies.

V.—OPEN LETTERS TO GREAT AMERICANS.

But other elements besides land and water and western brains and faith are essential to the rapid development of our new civilization. We must arouse the interest and secure the coöperation of powerful influences in the East and in foreign countries. I can call the names of a few prominent men who have it in their power to enormously assist in this direction. Let me address them briefly by means of open letters in this article.

TO EDWARD EVERETT HALE.

If you are not weary of good works wrought for your fellow men in the course of your great life, may we ask you to help us build the Republic of Irrigation? In other words, will you "lend a hand?" You have left your mark indelibly upon the old century. Will you help to mould the institutions of the new? Does it appeal to your reason when we say that we can apply the results of the world's experience more successfully on the virgin fields of western America than you can hope to do in the forest of traditions by which you are surrounded in Boston? If it were possible, by some agency of magic, to transfer during the night one thousand weary artisans of a tired Massachusetts community to twenty thousand fresh

acres of Arizona soil, and if next week they could be taking from their fields what they consumed in their living and sending to market a surplus sufficient for other requirements and a modest deposit in bank, would you consider that you were doing a service for your fellowmen in assisting to bring about the result? If so, may we not ask you to spread the fame of Arid America and its opportunities and help us to accomplish in two years, by practicable methods, what would be worth the doing if it were possible in two weeks by magic? And, by the way, irrigation and electricity are magic in their way, after all.

TO WILLIAM DEAN HOWELLS.

Can you not induce your "Traveler from Altruria" to take a trip to Arid America? We know he would sympathize with the lofty aspirations of those who are founding the Republic of Irrigation. As he would be a pioneer in this field he would find it easy to introduce reforms, since he would be relieved of the embarrassment of existing institutions. Our scheme of universal prosperity is nearer the earth than your hero's, and yet we sympathize with his aspirations so nearly that we would not ask a better name for one of our model colonies than "Altruria." Your estimable contemporary, Mary Hallock Foote, has given the world some very charming pictures of our Arid West. We cordially invite you to study the possibilities of our new and practicable civilization and make it the subject of your next novel.

TO CHAUNCEY M. DEPEW.

In your speech at the World's Fair on Manhattan day you remarked: "The depopulation of the country and the overcrowding of the city present to each municipality problems of employment and support which unsolved are dangerous to peace and property, and whose solutioners are not yet in sight." The institutions of Arid America hold out fair promise of a solution. Will you join the band of "solutioners" who are trying to carry this truth home to their countrymen? Will you lend your eloquent tongue—your potent influence—to the creation of a public sentiment which will support the men of the new West in their effort to develop new and better forms of civilization, based upon the small farm, industrial independence and the largest practicable measure of human equality?

TO WILLIAM VINCENT ALLEN.

We salute you as a Senator of the United States who knows the West and as the rising hope of a new party. You have lived the hardships of the pioneer in one momentous era of colonization. We need not ask where your sympathies are concerning a movement which aims to establish conditions guaranteeing a good degree of independence and equality to the average family. But we ask you to become a student

of the conditions existing in the western half of the United States and to assist in turning the attention of the people in that direction. You have only to thoroughly comprehend our objects to become our zealous champion. The eastern boundary of the Republic of Irrigation—and mind you, we use the word in its economic rather than political sense—will cut your own Nebraska in twain. If you will put your stalwart shoulder to the wheel we shall gain several years of valuable time. For you are a Populist Senator who enjoys the entire respect of Congress and the nation.

TO THOMAS B. REED.

We hail you as the first Eastern statesman to grasp the mighty significance of Arid America. In your speech at Pittsburg on the night of April 27th you said, with splendid eloquence:

Mighty as has been our past our resources have just been touched upon, and there is wealth beyond the Mississippi which in the not distant future will astonish even the dwellers on the shores of Lake Michigan.

From the time my eyes first rested on the great uncultivated plains which lie between the Mississippi and the Pacific ocean, my wakening dreams have been filled with visions of the incalculable wealth which the touch of living water will bring to life from those voiceless deserts. There wealth only can produce wealth, and man, singly and alone, might as well try to subdue the Himalayas as to cope with these wastes, but the hand of united and associated man is already reaching forth to grasp the great results.

The same power which wastes millions on the Mississippi can be utilized to make the desert blossom with the homes of men, for whom and for all of us the now blighted soil will bring forth the fruits of the Garden of Eden.

We recognize in these ringing words the voice of a statesman of national vision—almost the first New England has given us since the passing of Daniel

Webster. Will you help us to make real these "wakening dreams" of yours and these lofty hopes of your countrymen of the West?

TO ALBERT SHAW.

As editor of the *Review of Reviews* you speak to an audience which makes public opinion in this country. Perhaps no other man reaches so many people whom it would be desirable to have familiar with the future possibilities of our arid region. You are national in your sympathies. You are well acquainted with the West. You can do as much as any man to help us carry home to the American people the practical wisdom of developing, as largely and rapidly as possible, the resources of their great national estate. Will you give the influence of your powerful magazine to help us found splendid institutions and make homes for millions of people? And if you could gain the co-operation of William T. Stead you would do us a double good. We have heard his trumpet call for "the union of all who love in the service of all who suffer." A free translation of this great battle-cry would apply as well to our cause, for we want to see a union of all who believe in the destiny of the human race in the service of all who desire to find better conditions of living for average people.

THE MESSAGE MUST BE HEARD.

This is the message of the men of Arid America. It will be reiterated until the world hears and listens, and until the splendid proportions of the new civilization rise grandly against their mountain background in the new and Greater West.



A SENTINEL OF THE DESERT.—WESTERN COLORADO OR RIO GRANDE WESTERN RAILROAD.

ANCIENT AND MODERN ARIZONA.

THE GROWTH OF A NEW INDUSTRY ON THE RUINS OF THE OLD.

BY LINCOLN FOWLER.

WITHOUT question, irrigation was first practiced within the limits of the United States, on an extended scale, in Arizona. The primitive races to whose efforts the works are due were, perhaps, of the racial stock of which the Zuni and Moqui tribes are the later day representatives. Their work was probably to some extent influenced by the development of the Mexican system under the Toltec, Aztec and kindred races. The result of the work of archaeologists tends to place the termination of this era at 500 A. D. to 1200 A. D. Evidences of their works, buildings, temples and canals attracted the attention of the early Spaniards, and have ever since furnished "ruins" for the seat of ancient baronial estates. Early in the sixteenth century the Spanish explorers found only ruins and attending legends, and until the religious ceremonies and habits of tribes of the same parent stock were studied, little idea was really had of their true place in the history of the American continent. Lieutenant Frank Hamilton Cushing, under the auspices of the Hemmenway Southwestern Exploring Expedition, carried forward a work of very great ethnological value in helping to arrive at a theory for the solution of the questions connected with the settlement of the valleys of Arizona and northern New Mexico.

Many points of common origin seem to be indicated between the Zuni and Moquis and the prehistoric settlers of central Arizona.

Bandelier and others have also contributed to this research.

I.—ANCIENT WORKS.

A development of the waters of torrential streams, conducted to level plains and distributed through laterals running with the trend of the natural slope, seems to have been the principal part of their system. Of their works of diversion little can be known, but in all probability they were purely gravity and at most the rudest sort of weirs.

They also had a system of small reservoirs filled from mountain torrents, which were also used during the time of flood to irrigate fields. This plan is yet in use by some tribes of Indians for small planting, with fairly good success. It is not likely that the greatest development of the prehistoric era went beyond 1,000,000 acres in Arizona, and perhaps this was used partly or at different periods. A very large population of primitive agriculturists must have contributed to the construction of these irrigation works. The final development of their civilization supported

quite a numerous class of priesthood. They reached an age of polished stone implements, but it is doubtful if they knew the use of metals.

Their fabrics seem to have included the use of cotton, and some species of maize was probably their principal field crop. Among the Pima and Maricopa Indians of the Gila valley is to be found, perhaps, the nearest approach in central Arizona to the ancient races in methods of cultivation. Their chief characteristic is an agricultural habit. Under their method we see the basin system of irrigation applied to field crops. For harvesting with modern machines these small square basins would be prohibitory, but for these Indians, who harvest with sickles, very small amounts of water produce large crops.

II.—SPANISH AND MEXICAN.

A new era began with the extension of the rule of the Spanish Conquistadores who, for the glory of God and incidentally the accumulation of gold, spread over the semi-civilized countries of the western hemisphere, as well as the savage ones, wherever there was gold, either natural or accumulated by trade. In a very short course of exchange the Indians received from the pious Padres a sufficient supply of religion as an equivalent for the gold that might be had by enforced mining and virtual seizure of all hoards. To accomplish this and continue the beneficent work, agricultural operations were necessary for subsistence, and we find their spread coincident, in the main, with the extent of the mining region and allied industries.

To teach their converts to cultivate and irrigate after the manner of old Spain, in so far as they might be an improvement on the native methods, was likely no greater difficulty than to promote their attention to mining, and both together led to the establishment of the system of peonage lately abolished in Mexico. Though exploring expeditions went farther north, these hardy sons of Spain did not effect lodgment beyond the Gila river in Arizona, for wherever they encountered the Apache, that fierce interloper from the Arctic regions, an offshoot of the great Thlinket nation, Spanish swords were outmatched.

Among the Pima tribe, adjoining the Apaches, the Spaniards converted a part and found them satisfactory miners and cultivators of the soil. But an insurrection occurred during which the priests and papagoes or "cut hair" converts were driven out, almost completely putting an end to the Spanish occupation of Arizona.



FALL OF ARIZONA CANAL, SALT RIVER VALLEY.

We find that the progress of this period was limited and confined to the Gila river and its southern tributaries, and resulted in the occupation of a few thousand acres permanently.

The Spanish and Mexican plan of securing water was one of purely gravity, assisted by light and low dams or weirs for diversion. They believe in the theory that the better plan is to let the water run into the ditch, avoiding, if possible, the construction of weirs on sandy foundations, as nearly all river beds in Arizona are. This homely idea seems in some cases to have been ignored by modern engineers, and usually with serious results. Upon the farms they distributed water by means of ditches running across fields from 15 to 30 yards apart, out of which the water was thrown by dams until it covered the surface cultivated.

III.—AMERICAN DEVELOPMENT.

After the war of the rebellion, which had resulted in the almost complete abandonment of the Territory by the troops of the United States, the reestablishment of military posts and several successful campaigns against the Apaches led to cultivation under the Americans. This was nearly all by means of irrigation, commencing in the vicinity of Prescott and about Tucson a continuation of the Spanish and Mexican efforts.

In the northern part of Arizona the mountain valleys are unusually narrow where water is available, so that the aggregate area under ditch is yet small, and it has been found that in ordinary seasons corn and potatoes are quite successful as field crops without irrigation in many localities.

WHERE IRRIGATION IS ESSENTIAL.

After passing south of 34° of latitude, it may be said that no cultivation can be successfully carried on without irrigation. We find in the valleys of the Salt and Gila rivers the largest area of irrigated land, an extent now provided with canal system amounting to over 1,000,000 acres, and under process of construction and extension quite as much more.

Among the more notable works is, the Arizona canal, 40 miles long, having a weir in the Salt river nine feet high and 900 feet long. This a private corporate work.

CO-OPERATIVE CANALS.

The Grand, Maricopa, Salt River Valley, Tempe and Utah, near Phoenix, are very good examples of the result of coöperative canal building by farmers, and are all successful. The Mesa, Buckeye and East Riverside were built by farmers, and after a time passed under the control of companies by contract. The Florence canal of Florence, Arizona, and Peoria canal of Gila Bend, built by companies after absorbing the rights of several predecessors are now

apparently on quite secure footing, with strong probability of a vigorous and successful future under new management. A number of small ditches have been operated near Tucson for many years past, with good results, though much larger works are now being built by Allison Bros. to tap the underflow of the Santa Cruz.

THE FLOODING SYSTEM.

On the upper Gila at Solomonville and near St. John on the Little Colorado, as well as near Yuma on the lower Gila, small ditches cover limited districts. Very generally the plan followed by the American irrigators is one of flooding the land by means of small ditches at the upper side of the land to be irrigated, the final distribution being accomplished by means of borders 15 to 25 yards apart, between which the water is successively turned, until the whole field has been wet. This is repeated when necessary. An amount of water equal to 18 inches deep covering the land in crop is ordinarily enough for annual crops, but perennial field crops, as alfalfa, require at least 30 inches in depth applied at successive irrigations during the year. For fruit culture a greater amount is applied at a single time, by means of small trickling streams along rows. This is retained by active cultivation, which has also the effect of keeping the soil well aerated.

THE TANK SYSTEM.

Some advanced horticulturists are now advocating the tank system of irrigation, and are building borders around four or more trees, or an equal amount of vineyard, designing to hold a quantity of water on a separate block. The loss of facility in aeration of soil will probably cause this system to be discarded for perennial crop or orchard and vineyards, though, as practiced by the Pima and Maricopa Indians, for annuals it is quite successful, where the fields have six months' time of fallow.

PUMPING.

Water is being pumped at Yuma, near Phoenix, and at several other points in the Territory with limited success under present systems, and the acreage so irrigated is as yet small.

WATER STORAGE.

The Florence reservoir on the Florence canal, about 20 miles from the head, covering 1,800 acres 12 feet deep on the average, is at the present time the only storage works for irrigation in Arizona. This is deemed a great success.

Many other eligible localities awaiting capital are known, but so far little has been done even in exploration and surveying to ascertain what might be accomplished in the conservation of the flood waters of torrential streams having their source in the mountain region, and debauching through mountain

valleys and gorges to the plains below. These offer all the physical advantages for successful places of water storage. The rainfall of the pine and oak timber region, covering a large portion of the eastern and northern part of the Territory, is over 20 inches per annum, and of this an unusually large percentage is runoff, from the fact the mountains are quite precipitous, making the need of reservoirs much more urgent. Along the Gila and Salt River valley region there is now a ditch system capable of extension to cover a very large additional area of easily irrigated land of good quality. This would make the distribution of reservoir water easy and quick to accomplish, especially so as there are already large and thriving settlements of farmers to draw settlers from. For the investor of capital this is a most promising field.

The area of good land which might be reclaimed under a system of reservoirs, in southern and western Arizona, would reach into millions of acres. As to the amount of water available there is every season a sufficient quantity of flood water, if conserved, to cover an acreage far in excess of the total now cultivated.

NEW OPERATIONS.

Operations have been commenced on the Agua Fria, near Phoenix, on Bill Williams' Fork, on Cave creek, and by the South Gila Canal Company, with a view of extensive works for storage of irrigation waters. Several others are projected on Salt River the Gila, Rio Verde and Santa Cruz.

There has also been some consideration given to several places where there is often flood water at points favorable for storage not on any streams, but to catch the drainage of large valleys. These valley sites present some features of considerable advantage.

UNDERFLOW.

From the natural conditions of surface configuration, Arizona presents an interesting region to study this subject.

Arizona has been termed over-drained. This is true in the northern plateau region, bordered at the north by the Grand Canyon of the Colorado, which reaches a depth of 6,600 feet. On the Arizona side many deep and narrow canyons drain off all water rapidly. This leaves large districts without accessible streams of water, though in a region of comparatively abundant rainfall.

Through the central and eastern part are heavy ranges of mountains, cleft in deep canyons and mountain valleys, which at an elevation of about 2,000 feet widen out to large and fertile plains, with isolated ranges and peaks.

Many smaller streams, when reaching the valleys, sink from sight during most of the year, and appear

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IRRIGATION MAP OF ARIZONA.

only where a foundation of bedrock forces the water to the surface. The diversion of this underflow has not yet been accomplished, though in several localities parties are working at it. There seems no reason to doubt that at slightly greater expense than has attended the diversion of surface water from the streams, the underflow might be had with a result of adding nearly, if not quite, as much as the present permanent supply, outside the Colorado river. The grade of the rivers is quite favorable to a development of this source of supply.

ARTESIAN WELLS.

Artesian water has been found at Fort McDowell, in the Sulphur Spring valley and near Pinal. Many wells which do not furnish flowing water have been used with pumps, and in many cases water is in sufficient volume to supply enough for large irrigation works. This is notably the case in the Phoenix City water-works, all the water necessary being pumped from one well without nearly reaching its capacity.

IV.—THE COLORADO RIVER.

This great waterway, rising in the Wind River range of northern Wyoming, intermingling its sources with the Missouri and Columbia and draining a large part of the western slopes of the Rocky mountains in Wyoming and Colorado, courses through the most magnificent canyon of the known world in northern Arizona, and runs through a long stretch of valley along the line of Arizona and California, forming the boundary line for about 200 miles.

From the southern boundary of California to the Gulf of California, a distance of about eighty miles, lies a region formed by the wash of silt from the Colorado river making an alluvial plain partly in California and Lower California, and a smaller amount in Arizona. Various plans for irrigation works to cover this delta region are being pushed, notably the Colorado River Irrigation Company. The use of the waters of the Colorado and development of the lands in its delta presents some interesting international features of irrigation. It would seem that the topography of the Colorado river valley is such that water must be taken out at a point some miles above Yuma on the line of California and Arizona for irrigation of the great delta plain. The line of canal will run through California on the west bank of the Colorado, passing into Mexican Territory and thence northward into California to cover a large area of rich land, formerly delta region but now a typical desert and much of it lying below the sea level. This is known as the Salton basin.

The points most apparent will be, first, the rights of California and Arizona to the water of the Colorado, since each may use and need water for irrigation. Next the exact definition of rights between the

United States and the Republic of Mexico as to the ownership and distribution of the water on the California side of the river, since but little can be used until it has passed into Mexico, when a very large extent of ground may be irrigated, but without the protection of a treaty but little might return to the United States from whence it was taken.

This would not be the case on the Arizona side, as all use possible would be made before going into foreign territory. After entering Mexican lands the river reaches so low a level and the channel becomes of such character that it is very probable that no successful diversion within reasonable cost could be made. It would seem in a treaty covering these points that the United States might reasonably ask for a port on the Gulf of California for the benefit of the region between the coast range of California and the continental divide of western New Mexico, thereby promoting trade between the northern and western States of Mexico and the great region which will develop by irrigation on the watershed of the Colorado. Above Yuma and below the Grand Canyon there have been several small efforts to irrigate both by gravity and by pumping with indifferent results. Several rich districts of placer mining ground contiguous to the Colorado will help establish the development of water that may later be used for irrigation.

From Yuma southward, the Colorado has its channel in an alluvial plain, which towards the north and west is much lower than the high water mark of the river. Of course, during extreme freshets, large lakes are formed, and a few years ago, the flood water went over the barriers and poured down into Salton basin. Sufficient evidences remain to show that at a comparatively recent period, this region was filled with water, perhaps several times. It is of very great interest, since a change is within reach of easy probability, to consider what the effect on the climate of Arizona and eastern California would be if the Colorado river water should become permanently diverted to this basin. This would form a lake about 100 miles long and from 20 to 40 miles wide, taking the place of an almost totally dry region of very great heat. It seems probable that it would modify the climate of the lower part of the Colorado watershed, affecting almost the whole of Arizona. As there are evidences of the presence of water to the extent of a large lake quite recently, a condition supported by the traditions of the Indians now resident in that vicinity, may it not be supposed that the prehistoric cultivators of Arizona owed much of their acreage to the greater rainfall and more abundant supply of water in the rivers thereto, and, finally that when the Salton lake dried up, the lessened amount of rain falling in Arizona weakened, and ultimately caused their extinction.



VIEW OF CARSON CITY, NEVADA.

LOCATION OF THE NEXT IRRIGATION CONGRESS.

DURING the month of May the Executive Committee will vote upon the important question of the location of the next session of the National Irrigation Congress. The call will be issued about June 1st and the committee, acting in cooperation with the citizens of the place chosen, will then enter upon three months of energetic preparation for the event. Several cities are in the field as candidates for the honor of entertaining the next congress and as a preliminary to the action of the committee the claims of the various cities are submitted in this number of *THE AGE*. Not only have the constituents of members the right to express their wishes in the choice of a convention city, but there is no doubt that members will be glad to be advised in this matter.

IT WILL BE A GREAT EVENT.

The next Irrigation Congress will be an event of national importance and easily the greatest thing in the history of American irrigation. Many circumstances will combine to make this the case. Every day that has elapsed since the adjournment of the five days' session of the International Congress at Los Angeles last October has added something to popular interest in irrigation. Furthermore, the condi-

tions existing throughout the United States render the twin subjects of irrigation and colonization matters of the most urgent national concern. The people of the East are sharply realizing that they have a surplus population. Naturally they are turning to the West, which has always been the outlet for surplus energies and people, and to the great national estate, consisting of 800,000,000 acres of arid lands, a portion of which is arable and irrigable. Still further, seventeen States and Territorial commissions are now at work formulating the views of their citizens concerning a national irrigation policy and a code of laws common to all the States. The reports of these seventeen commissions will be presented and discussed and two committees on resolutions one dealing with national topics and the other with State problems will endeavor to blend the various views into harmonious policies on which the people of the West may enthusiastically unite. It is probable that the controversy precipitated by the celebrated speech of Major J. W. Powell at Los Angeles will be reviewed in the light of his explanations and the replies of his critics, and that the Irrigation Congress will give to the world a clear, definite and final statement of western opinion concerning water supplies and irrigable public lands. Further than that, there

will be a rich programme of general and varied interest. The congress will probably be in session for a full week and will be followed by several days of excursions to points of interest in the neighborhood of the city where it is held. The National Committee will arrange with the Associated Press and United Press to report the proceedings fully from day to day and with the more important newspapers to send special correspondents.

CONSIDERATIONS THAT SHOULD GOVERN THE CHOICE.

Probably there is no important city in the arid region which would not be proud and happy to entertain a congress of this importance, especially in view of the fact that it is likely to be attended by from 500 to 1,000 delegates, and perhaps twice as many spectators. This means a national advertisement to the city and State where the event occurs, as well as the expenditure of several thousand dollars locally. Neither is there any city or State which would not be benefited, directly and indirectly, by the presence of the Congress. But there is one supreme consideration which should rule the choice, and this is the success of the event itself.

If the Congress should be located at a point not reasonably accessible from all points of the western country, or at a point lacking sufficient facilities of entertainment or attractive surroundings, it might fail of its highest purpose. The congress presents a magnificent opportunity for the accomplishment of great results. Properly organized and advertised and rightly located, it will put American irrigation years forward. Under these circumstances the casting of a vote for its location becomes an important duty, which ought to be carefully considered by every member of the committee.

After the proper discharge of the duty to the movement as involved in the success of the convention itself, it is proper to consider the advantages which would result to certain localities. There are several cities and States in the arid West which need the impetus which the convention would give it. There is no city or State which could not urge the justice of its selection upon these grounds. Nor is there any which members of the committee would not be glad to see enjoy such benefits, but it is manifest that only one of many such places can be so favored this year. In 1891, Salt Lake City, capital of the intermountain region, received the honor. In 1893, it was conferred upon Los Angeles, to the benefit of the Pacific coast and the Southwest. The people of Montana made a strong effort to obtain it in 1893, and this year Nevada, Colorado, Idaho and New Mexico are in the field.

I.—DENVER, COLORADO.

The first invitation was received from Denver, Colorado, although Carson City, Nevada, was close upon its heels. Late in the afternoon of the fifth day of the International Congress Mr. J. F. Rocho, member of the National Committee for Colorado, took the floor and said: "Mr. President and gentlemen of the Congress, during my absence on the Committee on Resolutions a telegram was received from the mayor of Denver, sending a cordial invitation to this congress to meet in Denver, next year. I wish to heartily endorse this invitation, not only in behalf of the people of Denver, but of the whole State of Colorado." He then enlarged upon the advantages of choosing Denver, and was immediately followed by Mr. Merrill of Nevada, in an eloquent speech favoring Carson City.

Mr. Rocho now writes as follows to *THE AGE*: "Denver made the first application for the honor of entertaining the National Irrigation Congress of 1894. The telegram of the mayor of Denver and my own address to the Los Angeles convention, were followed at the proper time by a formal proposition from the Denver Real Estate Exchange, containing an offer to expend \$1,500 in advertising the convention, to provide suitable accommodations for the National Committee and a good hall for the convention, and to pay the expense of obtaining and publishing a complete stenographic report of the proceedings.

"Denver bases her claim upon the interests of Western America as a whole. She makes no selfish appeal in her own local interest. The first congress met at Salt Lake, which is the exact geographical center of the arid region. Naturally it was most largely attended by the people of the intermountain region immediately surrounding it. The second congress was held at Los Angeles on the extreme western border of the arid region and representatives of the Pacific coast far outnumbered numerically all other parts of the arid region combined. Nevada is a part of the Pacific coast—politically about the same thing as California—and was well represented, as it should have been, but Colorado, Wyoming, the Dakotas, Idaho, Montana, Utah, Washington and Nebraska had only one delegate each, possibly excepting Utah, and in several instances that one was really a Californian representing the other States by proxy. If this was the result in a Pacific coast city so attractive as Los Angeles, what kind of a result could we expect in a Pacific coast city as remote and inaccessible as Carson? The first congress having been held in the center, and the second on the extreme western portion of the arid region, we now ask in the name of Arid America as a whole that the third and greatest congress shall assemble at Denver, the metropolis of the eastern section. Although far east as compared

with Los Angeles or Carson, Denver is still largely central. Five irrigation States and one Territory are further east than Denver. They are the two Dakotas, Kansas, Nebraska and Texas, with Oklahoma. Beside this Illinois, Tennessee, Georgia and Florida are now represented in our National Committee. More important than all, we hope to attract interested spectators from all over the East and South. So I say, on the score of geographical location, Denver is beyond all comparison the place of places.

"Denver's claim is equally sound from a railroad standpoint. Carson has one railroad, and a branch line at that. Boise has one railroad and Albuquerque two. Denver is the junction of seven great railroad systems, and as originally built, practically twelve. We have the Union Pacific, the Missouri Pacific, the Rock Island, the Denver, Fort Worth & Texas, the Atchison, Topeka & Santa Fé, the Denver & Rio Grande, and the Chicago, Burlington & Quincy. East, north, west and south great railroads connect Denver with all sections of the United States. This means the lowest rates, best accommodations and largest favors in every direction.

"So with the matter of hotel accommodations, Denver also leads all other cities. The Brown Palace hotel is the most beautiful and best appointed hostelry in the United States. We simply do not take a back seat for anything. Besides that we have dozens of other good hotels ranging from \$1 a day up. The city has fine theatres, restaurants, street-car service and is full of attractive sights to employ the leisure moments of delegates. It has four great daily newspapers to report the event.

"When the Congress adjourns excursions can be planned to the historic colony of Greeley and to any number of interesting irrigation works and attractive communities. Colorado ranks second to California in extent of irrigation development. Then we have Manitou, Garden of the Gods, Glenwood Springs and other attractions of mountain, valley and plain sufficient to keep the delegates with us for months. And they would be having a good time and learning something worth knowing during every moment of their stay.

"I have said that Denver would not appeal on selfish grounds, but as Carson, Boise and Albuquerque can appeal on no other reasonable pretext, I will copper them there. What State bore the brunt of last summer's wild crusade against silver and everything western? What State held her head proudly and served notice upon the world that the West was too great to be broken down by the failure of a single industry, no matter how representative that industry might be, or how cruel the methods by which it was undone? It was the State of Colorado. She was made to suffer in the eyes of eastern and

foreign investors for the crime of the common West—the crime of insisting on the restoration of the money of the Constitution. What State deserves the benefit and the vindication which this congress will give more than Colorado deserves it?

"Mr. Chairman, I move to make it unanimous for Denver. I think even Gen. Jones of Nevada will withdraw in our favor, for Arid America is greater than any State and her interests dearer than the aspirations of any city."

II.—CARSON CITY AND ITS ATTRAC-TIONS.

As the time approaches for the National Executive Committee of the Irrigation Congress to decide upon the location for holding the next meeting of its congress; and as Carson City, the capital of the State of Nevada, has tendered its proposal and extended an invitation to the committee, competing with other cities for securing the said Congress to meet and hold its next session within her gates; it may not be deemed inappropriate to present to the consideration of the committee and others interested in this national movement, a short article descriptive of Carson City and its surroundings, its beauty and various attractions, showing the feasibility and propriety of selecting said city as the place to hold the congress.

As Nevada is regarded as one of the healthiest States in the Union, possessing all the elements in natural resources, as well as in mining and agriculture so Carson City is universally conceded to be the most healthful, pleasant and beautiful place in the State.

At the base of the lofty Sierras, and at an altitude of 4,660 feet, in a picturesque and romantic spot, lies Carson City with a population of about 5,000 souls; laid out with regularity and precision, illuminated with electric lights, its streets and avenues adorned with shade trees, its lawns and principal park with flowers, its resident portion made up of beautiful and attractive homes, its business blocks constructed in a substantial manner, while an abundance of clear, cool, delicious water is supplied from the towering mountains which rise so grandly near the city.

The Capitol building is neat and substantial, situated in the center of the city, surrounded by shade-trees and lawns, which constitute a park of more than ordinary attraction.

Besides being the seat of Government, there are located here—the State Orphans' Home, State Prison, State Printing Office, the United States Mint, United States Land Office, and the Government School for Indians.

The State library contains one of the finest and

largest collections of law and other works on the Pacific coast.

Our public schools are equal to any on the Pacific coast, while churches of various denominations and fraternal societies are represented.

Carson City is the headquarters of the Virginia & Truckee, Carson and Colorado railroads, and the central shipping point of all live stock east and west.

It is surrounded by many natural attractions and resorts—among which, and deserving special mention, are the celebrated “Shaw’s Warm Springs,” renowned for their medicinal properties in rheumatic and kindred ailments. A pleasant drive over smooth roads of sixteen miles in a southerly direction brings the tourist to “Walley’s Hot Springs,” conceded to be equal, if not superior, to the hot springs of Arkansas. Fourteen miles westward, at an elevation of 6,200 feet, lies the world-renowned Lake Tahoe—famous as a resort during the summer season. This entrancing sheet of water is reached by daily stage to Glenbrook, a cosy little village on the lake shore, where steamers, which ply around and across the lake during the day, are in waiting; and at night, moonlight excursions, with music and dancing, go to make up attractions which the tourist thoroughly enjoys. Hotel accommodations are first-class and reasonable at all points of the lake.

A drive of sixteen miles northeasterly, or a ride by rail of twenty-two miles up the mountain sides, over the most crooked or winding railway ever constructed, brings the traveler to the “Comstock Lode,” situated at an altitude of over 6,000 feet. Who has not heard of this famous lode, and the discovery of its immense deposits of silver and gold—the most valuable and extensive ever found in America? Grand, instructive and interesting to the tourist will be the perpendicular shafts sinking 3,000 feet into the bowels of mother earth, the enormous hoisting works and powerful mining and pumping machinery. Descending a shaft 1,750 feet the tourist will find a locomotive and car to transport him again to the sunlight—emerging at the town of Sutro, four miles distant.

Virginia City, built over this famous lode, with Gold hill contiguous, and Silver City, securely nestle at the base of old Mount Davidson, whose towering summit apparently pierces the clouds, nearly 8,000 feet above the level of the sea.

Will the lover of the grand and majestic in nature now accompany me and ascend to the top of Mount Davidson—this lone sentry whose summit greets the clouds, and behold a panoramic view that few mortals have been permitted its equal to witness?

Looking to the westward you behold the snow-clad Sierras, and wafting from their lofty summits you inhale the balmy air, freighted with the incense of fir

and pine. At their base you see the Truckee river like a silver thread winding its course eastward through a most beautiful valley to its final resting place. On either side of its banks lies the prosperous town of Reno, where the State University and other State institutions are situated, while the surrounding country is dotted with prosperous farms—characteristics of a thrifty people. Little further south your eyes are directed to Washoe lake and valley, whose waters glisten like a silver sheen at your feet, and whose shores are fringed with farms and orchards. To the southwest your vision will rest to survey Carson river and its fertile valley, the town of Genoa, surrounded by elegant farm houses with all modern improvements concomitant thereto, three large creameries where the choicest of butter is made, while waving fields of grain and alfalfa greet the eye at every turn. The Carson river courses its way for more than 100 miles in a northeasterly direction, discharging its waters into two lakes.

To the south and southeast you may view Mason valley, through which the “Walker” runs, finally emptying into a lake bearing the same name near Hawthorne, in Esmeralda county. This is an extensive valley, capable of supporting a large population, and a desirable place to establish colonies. Looking eastward for a distance of over 100 miles you survey across Churchill county until the eye meets the summit of the Augusta range of mountains, where Grant’s Peak rears its lofty head, capped with eternal snows.

Gradually retracing your survey in a westerly course, until your vision rests at the base of the “Old Mountain,” fringed with leafless sage and scattering juniper, low down along the murmuring brooks and streams, may be seen willows, cottonwood and other trees skirting their banks, while among the shelving rocks and pine you may imagine in the dim shade the figures of ancient castle-domes rudely fashioned among the gorges and canyons, which sight would be sufficient to inspire the poet to sing of the grandeur, majesty and beauty of the scene.

To the wooer of Dame Fortune, what flights of fancy his imagination may conjure! To what depths of reverie may he not speculate when becoming conscious of his situation!—for almost under his feet lie the caverns of the Comstock lode, where its treasures were and are imbedded, and from whence was poured into the lap of commerce and trade untold wealth of the precious metals, furnishing to our Nation’s exchequer during the dark period of its existence a sufficient amount to support and restore its credit and make it possible for the early resumption of “specie payments,” besides a multitude of favors extended to our entire country. What further wealth is in store in this “old lode” may be only conject-

ured by those who seek for its favors and its treasures. Undoubtedly it has yet sufficient within its deep chambers to be instrumental in again revolutionizing our finances, our business methods and the morals of our Nation.

To him, who may be an intending settler or home-seeker that views this enchanting scene—how great will his astonishment be when informed that in the range of his vision there lies dormant, awaiting his peaceable conquest and possession, sufficient lands to settle and plant over 50,000 families—giving each from eighty acres and over in the most fertile valleys of the arid West; penetrated by railroads, where the products of the farm and orchard are accessible to the markets of the world. These lands which now appear but deserts will be made to give place to gardens, fruitful fields and smiling homes; where families can be reared and educated, and where, all over this vast domain, will be seen happy homes, and children's songs be heard under their own "vine and fig-tree;" where peace will dwell and where the blessings of prosperity, enlightenment and joy will be secured, and all this for a money value that is but nominal.

Yea, further, when these sons and daughters of our "battle-born" State become the worthy successors of that strong, brave and generous race which preceded them—a race that laid the wand of their genius and power on every obstacle which beset their path, melting it away by their touch, who blazed the trails for civilization and smoothed the path for generations yet unborn, and in whose wake cities sprang up as by enchantment, who reared temples for learning and religion, justice and industry, then the time will have arrived for the realization of our hopes, and the memories of these brave men will be embalmed with the bravest and sturdiest of pioneers—who from a wild and forbidden country created a sovereign State—who came with "pluck" only for their capital, and from it hewed out and embellished a Republic.

While this spectacular view is sufficient to excite the wonder and admiration of the naked eye, what visions of wonderment are displayed to the prophetic eye of the future! How entranced will the mind become as this scene opens to view surrounded by such gorgeous beauties and possibilities.

At his feet is an empire in extent, lying almost untouched by the hand of man—its present development but an iota—its future possibilities incalculable.

Lying between the fertile valleys described are situated the rock-ribbed mountains seamed with precious metals. To the west lies like an amphitheater the Sierra Nevadas with their untold treasures; which if properly and judiciously conserved by man, would transform this vast empire into prosperous communi-

ties—with fields of grain and golden harvests; where here and there throughout, towns and cities would be built, and manufacturing enterprises spring as if by magic—propelled by the energy of this conserved power.

With these prospects and untold future possibilities before us, supplemented by a climate unsurpassed anywhere, who can doubt the statement that they actually exist? And yet how few are aware of it—that here lies such a vast territory of such fertility—that here flows sufficient water if conserved to produce such mighty result, at such a low price, so accessible to markets and our productions to it yet so limited. Who can dispute that here lies a foundation for the upbuilding of an intelligent people, a loyal, brave and patriotic race! A people imbued with sturdy virtues, whose impulses are so generous, whose deeds are so just and whose lives so upright and pure that they will some day rise and shine in their might and become members of a sovereign State and of the brightest stars in the constellation of the Union.

All this with many other matters of interest, both natural and historical, form but part of the attractions to the visitor who comes to Carson City.

JOHN E. JONES,
Member for Nevada.

III.—ALBUQUERQUE, NEW MEXICO.

The Commercial Club of Albuquerque has addressed a communication to the National Committee tendering the hospitalities of the people of New Mexico to the next Irrigation Congress, in accordance with the resolutions passed by the convention at Deming last December. It is argued in favor of Albuquerque that the location would be satisfactory to New Mexico, Arizona, Kansas and Texas especially, while it would be reasonably accessible to all other parts of the arid region. New Mexico would be greatly benefited by a convention of this character. Strong influences are at work for Albuquerque.

IV.—BOISE, IDAHO.

The press of Idaho has been agitating the feasibility of obtaining the next congress for Boise for some months past. Committeeman Babbitt has not submitted a definite proposition, but it is probable that Idaho would meet the terms offered elsewhere. Idaho is one of the most interesting States in the arid region, is rather centrally located, and would repay a careful study on the part of the delegates. Like Nevada and New Mexico, it would doubtless realize substantial benefit from the session of the congress.

IN REPLY TO POWELL: HOW MUCH WATER DOES A CROP REQUIRE?

BY W. C. FITZSIMMONS.

IN the February issue of THE IRRIGATION AGE Major J. W. Powell, Director of the United States Geological Survey, discussed at length the question of the amount of water required to produce crops of various kinds. Among the statements made by Major Powell in this connection are these: "Cereals, such as wheat, oats, barley and corn, will exhale their dry weight in water every day. . . .

Two tons of hay require 200 tons of water, which is about 18 acre inches. If the crop of hay on an acre is two tons the acre of grass will transpire 18 acre inches of water." The distinguished writer alleges that these results have been reached after more than a century of labor among men of science in this direction. After admitting that to some extent it is a question of latitude, altitude, atmospheric humidity, etc., Major Powell sums up the matter thus: "In the western half of the United States, the mean absolute duty of water, plus the practically unavoidable evaporation, is 24 acre inches for every average acre of crop. Otherwise stated, an acre of growing crop will drink up by its roots and exhale by its leaves an acre of water 18 inches deep during one season, and in applying this water under economic conditions an acre of water 6 inches deep must be wasted by evaporation. The absolute duty of water is 18 inches; the possible duty, 20 inches; the practical duty, 24 inches."

All this, briefly stated, means that an average crop (of wheat for example) absolutely requires for its successful growth and maturity at least 18 acre inches of water, none of which can be spared by drainage, evaporation or otherwise. That this amount of water must be drawn from the soil by the roots of the plant and utilized in its growth by the processes of nature. But the inevitable waste by evaporation and otherwise requires a greater rainfall than 18 inches, and the minimum is fixed by Major Powell at 24 inches, without which an average crop is impossible. It is interesting to note in this connection that it has required a hundred years of scientific research to determine this point. Had it not cost so great labor and pains to establish in the scientific mind this ponderous theory there might be some question in the mind of the average layman regarding its truth. The writer hereof has not spent a hundred years investigating this important subject, nor does he make pretense of being what is generally understood by the gentlemen themselves when they speak of "scientists." But he believes he has a somewhat firm grip on a

few facts, some of which may be pertinent to this occasion.

Practically, and in a nutshell then, Major Powell says it requires 24 inches of rainfall to produce an average crop. Let us see: For thirty years California has been among the leading wheat growing States of the Union. Some seasons she has led in the amount produced and has always stood near the head of the list. The wheat crop has never failed in that State, and yet, broadly speaking, there is scarcely a wheat field in California, and never has been, whereon 24 inches of rain has fallen in one year. But assertion alone proves nothing; and, unlike Major Powell, it is here proposed to array incontestable facts and figures from the highest authorities to support the assertion above made.

From 121 different localities in California, in or near which wheat is grown on a large scale every year, the writer has compiled the following data from the records of the Weather Service in San Francisco, and they cover periods ranging from two to forty years: Average annual rainfall for the 121 stations, 15.5 inches. Minimum in any locality known to the writer to be a successful wheat-producing district, (Tulare), seven inches; maximum, (Auburn), 32.55 inches. Of the 121 stations, only eleven show a rainfall greater than 22 inches, and nearly all of them are in parts of the State where comparatively little wheat is grown.

To show that California's wheat crop is at least an average one, we may cite the fact derived from figures published by the United States Department of Agriculture, showing that for the past fifteen years the average yield of wheat by the whole country has been about 12 bushels, while that of California for 1893 was 13.3 bushels. The average of the whole country for the last crop was 11.2 bushels per acre, while that of some of the principal wheat-growing States east of the Rocky mountains was as follows: Michigan, 13 bushels; Ohio, 14.5; Illinois, 11.5; South Dakota, 9; Missouri, 9.5; Indiana, 14; Kansas, 8.4; Tennessee, 9; Minnesota, 9.6. It will thus be seen that the average yield of California, which was not an unusual one, was nearly 20 per cent. more than the average for the country, and notably greater than in Illinois, Dakota, Missouri, Michigan and Minnesota, where a much greater annual rainfall is found than in California. It may not be out of place to state here that the value of this practical test, showing that

much less than 24 inches of rainfall will insure a good crop, is greatly enhanced by the wide area covered and the total amount produced. The wheat acreage of California in 1893 was 2,620,490 acres, and the total product 34,852,517 bushels.

This necessarily implies a variety of conditions, since it is well known that the rainfall is exceedingly variable in California, owing to its wide diversity of surface and to the relations of various sections to the sea and the mountain chains.

TESTIMONY OF THE ALFALFA FIELDS.

Much alfalfa is grown in California, Arizona, Colorado and other sections of the arid region. In California it is not uncommon to cut five crops of alfalfa from the same ground yearly, each crop averaging two tons per acre. The crop is very often cut seven times per year, and the writer has frequently seen eight crops taken from the same field in one year. In California alfalfa may be and is grown with the most gratifying success under a rainfall of less than ten inches, and on land irrigated with a miner's inch of water to each four or five acres. According to Major Powell's theory, these crops of alfalfa hay would require at least 80 inches of water on each acre, in addition to ten inches of rainfall. It is perhaps enough to say on this head that no alfalfa grower in California uses anything like so much water as this, and it is well known that thousands of acres of this crop are annually produced with much less than one-half, probably less than one-third of the water demanded by Major Powell's painfully elaborated theory.

WHAT THE CORNFIELDS SHOW.

For the season of 1893 the 72,000,000 acres of corn in the United States yielded a trifle over 22 bushels per acre. The 71,775 acres in California yielded 32 bushels per acre, and, like the wheat produced, was not irrigated. Not only is it not customary to irrigate cornfields in California, but the writer has seen fields of corn grown in that State which yielded 75 bushels of ears to the acre, and on which not a drop of rain fell from the time the corn was planted until it was husked. Neither did it receive a drop of irrigating water, and it was produced in a region where the rainfall through a period of 19 years has averaged only 18.31 inches annually.

THE PRUNE ORCHARDS TESTIFY.

Not only are millions of bushels of wheat, millions of bushels of corn, millions of bushels of barley and tens of thousands of tons of hay annually produced in California without irrigation and under a rainfall

not exceeding 9 to 16 inches, but more than 100,000 tons of fruit are produced under similar conditions every year. Not to prolong this article to unnecessary dimensions, only the prune industry of a single county will be cited. A few of the prune orchards in Santa Clara county, California, are irrigated, probably a twentieth part of the area devoted to that crop. Broadly speaking, however, the crop is grown without irrigation, and there is a difference of opinion as to whether it pays to irrigate at all. And yet this county produces yearly one-third as many prunes as are consumed in the United States. In 1893 the crop reached an aggregate of about 35,000,000 pounds of cured fruit, requiring at least 100,000,000 pounds as it was taken from the trees. But this is only one feature of the fruit industry of California which flourishes over wide areas, and under conditions which Major Powell declares impossible. The stern logic of facts and actual experience is far more convincing to the average man than mere theories unsupported by mathematical deductions from a sufficient number of observed facts. The annual rainfall at San Jose, California, the center of the prune industry, during a period of 18 years has averaged only 14.52 inches.

All the figures given in this article are from official sources, and prove beyond peradventure that Major Powell's position regarding the amount of rainfall necessary to produce a crop is wholly untenable. If he should take the ground that proximity to the sea might account for a part of the success in California, it may be answered that nearly the entire area here considered is not near the sea, but in regions where atmosphere has no parallel for dryness in any State or locality east of the Rocky mountains. During a considerable part of the year the air is so dry over a vast area of the country under review that dew does not form, though the nights are cool, and water evaporates with wonderful rapidity. He has no ground to stand upon here. It is not a moisture-laden atmosphere that helps out, for there is little available moisture in the air; it simply means that the Major is mistaken, and that crops do not require anywhere near the rainfall which he alleges for their proper growth and maturity. If the deductions of Major Powell are the net result of a quarter century of work in the geological survey, a proper inquiry may well be: What is it worth to the American people?

[EDITORIAL NOTE: The article in reply to Major Powell on "Water Duty in Arizona," by W. A. Hancock, referred to elsewhere is unavoidably omitted, but will appear in June.]

THE ART OF IRRIGATION.

FOURTH PAPER: A FURTHER ANALYSIS OF THE MISTAKES OF EARLY IRRIGATORS.

BY T. S. VAN DYKE.

NOT only was the labor of irrigating the whole ground by the dams or checks described in the last chapter very great, but it required an amount of water that many did not have. The quantity of water used by the novice is so much greater than that used by the skilful hand that few could indulge their extravagant notions unless drawing from a good sized stream. Many a man who attempted to irrigate from a small stream, even with a dam at the head of his ditch, found that by the time the water had soaked the dry dirt that formed the ditch, and had filled the thirsty gopher holes that yawned fresh along its route every morning there was not enough to fill the large checks he had made.

Many a man, too, was compelled to irrigate from a well, and generally pump the water with a windmill. Sometimes he used horse power and occasionally a steam pump. But if the pump worked worth a cent its delighted owner generally found his bliss impaired by the well's giving out in a short time and requiring a day or so to fill again.

So, too, there was much sloping ground on which it would need too large a dam on the lower side to hold the water. The depth of the water was no objection, but the building of high checks bore too strong a resemblance to work, and very few people ever go into the sunlands to work. It was also liable to break out and damage the ground below with a rush of water, and this again was suggestive of perspiration.

For these reasons many naturally drifted into making a small basin around the thing to be watered. This was used more for trees and vines than anything else and was of many forms. Sometimes it was made small and filled several times in the course of a day or two. Sometimes it was quite large and filled only once. Sometimes it was deep and sometimes shallow, sometimes square and sometimes round or oblong. All these points varied with the whim of the owner and the lay of the ground. If the slope were considerable, then an oblong basin lying lengthwise along the hill needed less of a bank on the lower side. If water were scarce then the basins were made small and filled two or three times the same day, so as to make the water go down and keep it close to the roots of the tree instead of escaping on the sides.

These basins were filled in several ways, but the most common was with hose from hydrants standing above the ground every few yards through the

orchard. Sometimes it was done with a water cart, or a barrel mounted on a sled, or some other stupid device. The irrigator rarely ran the water in streams from tree to tree, because the land was not generally of the proper slope for that purpose, and he never dreamed of the expediency of making it so. Moreover, he generally had no water to waste and had to use hose to save it.

Instead of a basin a series of short furrows or troughs was sometimes made with a hoe or spade, two or three on each side the tree. And occasionally these were made in circles, or crescents, or spirals, or any kind of shape. The general effect was, however, the same.

Two principles were firmly held by all the early irrigators.

First, that the roots "must be trained down," else how could they help drying too speedily?

Second, that they must be kept "close to the tree," otherwise they would go out into the dry ground, which there was not water enough to wet, or which it was too difficult to wet.

By many more it was as firmly believed that cultivation of the soil would make it dry out the more quickly. If any did not believe this it was because they had never taken the trouble to think about cultivation at all. Pouring on more water was the favorite remedy for baking of the top soil, the same as in the other methods. A very few broke up the basins with a hoe or spade, but for a long time no one dreamed of breaking up the hard dry ground that filled all the intermediate space.

This hard, unplowed ground lying outside the basins and forming from three-fourths to nine-tenths of the whole orchard absorbed like so much blotting paper the water from the basins and evaporated it into the air with a rapidity that one who has never studied the working of capillary attraction on ground where the ducts are never broken can scarcely conceive. Everything thus grown in basins was practically grown in a flower pot. That the pot consisted of dry earth was, on account of the absorption, worse than if it had been of stone or wood, for its outer wall consisted of a debatable territory varying in size, which was in an ever changing condition of moisture. After each irrigation the roots were coaxed out into a region that, about the time they were well started towards it, would be too dry to sustain them, and the

tree was thus kept working for nothing. It was also difficult to secure in this way an even wetting of any of the ground. About the center there was quite certain to be too much water, and it was a long time before people learned that water should never touch the stem or stalk of anything if it can as well be avoided. Many trees were thus injured, and the orange and lemon especially suffered from gum disease or foot rot.

This method also trained the roots into the form of a brush, and down into the colder and more "sour" soil, instead of outward into the warm, rich topsoil. It crowded them together so much that unless fully supplied with fertilizers the tree would soon be starving. Under no circumstances could the ground about the roots be well supplied with air, because they were trained so far down that any loosening up of the soil without destroying too many of the fibrile or feeding roots was impossible.

In spite, however, of its disadvantages, it was in many respects remarkably useful, as we shall see elsewhere, and, though it should not be used when anything better can be had, it is by no means to be despised, especially when well done. The worst irrigation thus far described generally surpassed no irrigation, and that is why people cling so persistently to wrong methods. Partial success makes people extremely obstinate on these points. You can see in parts of California to-day the basin method in its very worst form in use by people who have had the best of opportunities to learn the evils of it, but still follow it at a steady loss.

The difficulty of spreading water evenly over the top of the ground and the annoyance and ruin sometimes caused by the baking of the ground under the hot sun a few days, and often only a few hours, after the water was taken off, naturally led some to think of applying the water beneath. Two good object lessons in sub-irrigation were already at hand. There were places where the water in valleys stood in a sheet below at about the same level year in and year out. Marvelous corn, pumpkins and other crops grew on such land. Some tracts that used to be dry were made wet below by water soaking from the ditches, and land that was once desert showed wonderful fertility when the water rose to a few feet from the surface. In other places the soaking of water beneath the soil down a slope below a small spring developed a remarkable growth of vegetation during the dry season. In some places the same effect was found where the water from the winter rains followed a sheet of clay, hard-pan or even the bedrock of the hills down some long, smooth slope.

From these two things it was natural to conclude that if the water could be distributed underground all the annoyances of irrigation would vanish. The

first movement of any importance in this direction was a system of continuous pipe of cement and sand laid in a trench and covered over. Openings were made at the proper places for the issuance of water which, from that time, was supposed to do its own spreading in all directions and with proper evenness. This should have seemed a very violent supposition to one who knew anything of water, the most contrary of all things. But upon this principle was based and must be based all sub-irrigation theories. All the arrangements for the carrying and delivery of the water in the pipes were good enough, though quite expensive, and the cry of "Eureka" went far and wide in California, the only place in which it was tried to any extent.

One thing alone would have made a failure of it in any country having a long, dry season. Roots will enter any place where there is water or even moisture, and there they will stay and spin threads and skeins and all sorts of beautiful network. And the distance they will go to indulge this taste is quite wonderful. The openings of the pipes were soon stopped by snarls of fine roots and the expense of cleaning them out was so great that the system was abandoned. The roots also went through the slightest crack in the body of the pipe, and as cement is sure to crack sooner or later this always added to the difficulty.

But there were other objections which in any way of applying water under ground, except for a few things, seem insuperable. It is now well known that though berries and some few kinds of vegetables will do well on the hillside having a sheet of water sliding down the bedrock or hard pan beneath, the majority of things will not do as well as where the water is applied to the surface only with the ground open enough below to carry off quickly any surplus of water. The same is true of bottom or valley land irrigated by a sheet of water rising from below. Alfalfa, corn and some other things do very well on it. Grapes are apparently not injured unless needed for wine. Pear trees stand it quite well. But it is death to some things, sickness to others, and more or less of an injury to nearly all valuable products. Without very expensive appliances sub-irrigation cannot be used to any extent unless there is some sort of a hardpan below to hold the water. And that is exactly what you do not want for most things. If there is anything of that sort it should be broken through with dynamite so as to let the surplus water out.

Unless there are several openings for the water and distributed properly over a certain space, it is nearly impossible to get a uniform wetting of the ground by delivery of the water underneath. Some parts will be too wet and some too dry. At the next irrigation it is not certain that the same part that was wet enough

before will be as wet now. It also keeps the tree growing in a flower pot as much as the basin system in its worst form, because it is impossible to make the wetting spread very far from the center unless the water is kept flowing a long time, in which case the center is sure to become too wet. Even then you could not wet the whole ground with anything like uniformity. And if the soil is open below so as to give the drainage that it should have most of the water will run away below so that your water pipes as well as water supply will have to be large. It also tends to wet only that part of the soil that is cold and sour and does not wet sufficiently the warm, rich, top soil from which nearly all products draw the most of their food when growing well. To obviate these objections would take a plant far too expensive for

any but the most valuable crops, and these generally on a small scale. For such things as strawberries which it is essential to keep free from dirt and where an excess of water is not likely to do much harm it might be used to advantage, although they can be kept clean in surface irrigation by the use of a little tan-bark, straw, gravel or similar stuff in the furrow in which the water runs.

Sub-irrigation is very attractive to the imagination, and from time to time is certain to arise somewhere as a new conception, but it has been thoroughly tried in California, and no expense has been spared to make it effective. For heavy work it is wrong in principle, and has been generally abandoned, even by its most enthusiastic patrons.

SOME COMMENTS ON PROF. BLOUNT.

BY CHAS. W. GREENE.

I HAVE read with much interest an article in the April number of *THE IRRIGATION AGE* by Prof. A. E. Blount upon "Ideal Irrigation Methods in New Mexico,"

I agree with most of his statements of fact and with many of his conclusions, but I shall take issue with him upon some minor points. Under the caption, "When to Apply Water," he states: "No crop but tells us when it wants water. The grasses, clovers and small grain have a language that cannot be mistaken. Whenever their green color becomes very dark and sickly, put on water." I undertake to say that a cultivator who waits for that condition before he puts on water will not be sure of getting a good crop. It must be judged beforehand whether the land is in good condition to receive the seed, and from the time the seed is put in the ground there never should be a moment when the crops should be compelled to call for water. It ought to be supplied to them, not in an overabundance, but with discrimination and foresight. In farming, as in all other business, "foresight" is very far better than "hind-sight," and the necessities of the crop should be understood beforehand and every contingency provided against.

Again, I should take issue with Mr. Blount as to his method of irrigating an orchard. While it may be entirely satisfactory and give good results while the trees are young, such a plan as he suggests would, in my opinion, fail to produce the largest growth or the best results in products. There may be a disadvantage in having weeds grow, but I should call it a lazy man's method to leave the ground unirrigated and necessarily uncultivated to avoid the growth of weeds. I do not believe where water is confined to an encircling ditch around the trees that the best re-

sults can be obtained in orchard planting. It will assuredly make a sort of pot system, and the growth will be more or less restricted. No one can tell just where the terminals of the roots are, and it is at the extreme points of the fibrous roots that the moisture is most needed. If, then, it is confined closely around the trunk of the tree, it must be furnished in an abundance there, which is not only unnecessary, but injurious, while the fibrous roots at the extremity are working their way into dry ground.

I believe that the land should be thoroughly irrigated all over and that it should be as thoroughly cultivated from the time the tree is planted until it has reached its full growth and productiveness. The land should be graded to a uniform plane and the direction of the furrows should be fixed to secure an even flow of water over the entire surface, and the rows should be planted with a view to the distribution of the waters. If it can be watered two ways, the one at right angles with the other, so much the better. I fully believe in the furrow system of irrigating on all ground where it is practicable, and especially in the orchard. There is not the slightest objection, in my mind, to the raising of beans, peas, Irish or sweet potatoes, or vines between the trees, provided there is a sufficient supply of moisture furnished for the wants of all the plants. I believe it will benefit the growth of the tree rather than retard it; and whether they are in rows or not, I should insist that the ground be thoroughly cultivated, and that it should be cultivated at least twice where it is watered once. I agree with Mr. Blount that the water should not touch the trunks of trees, nor should it be allowed to touch the stem of any growing plant if it can be avoided.

TALKS WITH PRACTICAL IRRIGATORS.

RAISING SUGAR BEETS BY IRRIGATION.

IT has been alleged that beets produced by means of irrigation for the Lehi, Utah, factory during the past season contained less saccharine matter than those produced elsewhere without irrigation. While it may be technically true in this particular case, that the irrigated beets did not assay so rich in sucrose as those produced in California, without the aid of artificial moisture, it cannot with reason be alleged that sugar beets may not be successfully produced by means of irrigation. The sugar beet, like other plants, requires for its proper growth and maturity a certain amount of moisture. Whether this be supplied by natural processes through the usual rainfall, or whether properly applied by artificial means can scarcely make a radical difference with the plant itself. It depends upon the appliances for delivering the water at the proper time in suitable volume, and upon the good judgment of the irrigator.

It is easy to use too much water in the production of crops. Indeed, when water is plentiful and easily obtainable, the common practice is to use an excess rather than too little. This was no doubt the case at Lehi last year, and it is not at all improbable that the farmers learned a valuable lesson in this connection from the lower price received for their product, due to too much water and too little sugar. A few years of further experience will no doubt indicate to the Utah beet growers the proper quantity of water to be applied to their fields, and the proper times to apply it. In this case they will enjoy a distinct advantage over their brother growers in non-irrigable sections; for while the latter must take chances with the ever precarious rainfall, the others may regulate the growing of their crops with ease and comparative certainty. Recent experiments in Colorado under irrigation corroborate the views here expressed, as well as those heretofore uttered in the columns of THE IRRIGATION AGE, relative to this general subject. Near Grand Junction in that State, experiments with fifty acres of beets were tried during the past year, and the results were reported to the department of agriculture by Mr. C. E. Mitchell, of Grand Junction. From the beets produced on the fifty acres, comprising a variety of soils and conditions of culture and irrigation, twenty-four tests were made by the experts of the Lehi factory in Utah. The amount of sugar found in these beets was seen to vary considerably,

and to range from 10.4 per cent. to 17 per cent. The average of the 24 samples assayed was 13.9 per cent. While the average was not high, yet it made a merchantable beet, and the fact that so high a sugar content as 17 per cent. was found in some samples, shows that the sugar need not be leached out of the beets by too much irrigation during the period of growth. The average yield of this Colorado crop is given at fifteen tons per acre, and the cost of production \$45 per acre. While it must be conceded that this could not have been a highly profitable crop, yet it points to reasonable probabilities of lucrative returns, when the conditions of production are better understood and applied. In this connection it may not be out of place to quote the language of Professor H. W. Wiley and Dr. Walter Maxwell, of the department of agriculture, in a recent report published by authority of Secretary Morton.

RELATION OF IRRIGATION TO SUGAR BEET CULTURE.

"In former reports attention has been called to the probable practical value of irrigated lands for the production of sugar beets. The high fixed charges which must necessarily attach to all irrigated lands render it imperative that some crop should be grown capable of intensive culture and of yielding large financial returns. There is no crop which offers so many advantages of this kind as the sugar beet. The growth of potatoes or vegetables for home market, or of any crop of this kind usually produced by intensive culture, must necessarily be restricted to a limited area, but the comparatively unlimited expansiveness of the market for sugar renders it possible to devote practically all of the irrigated lands which are likely to be recovered in many years to the production of the sugar beet.

"In view of the magnitude of the interests involved a recommendation for the establishment of an experimental station for beet culture in an irrigated region ought to carry great weight with Congress. In fact, it is highly desirable that the experimental results which are so necessary to the proper development of the industry should be obtained under conditions varying as widely as possible. The production of beets in a climate as fickle and capricious as that of Nebraska is well illustrated by the experimental station at Schuyler. The production of beets without irrigation and without rain in the valleys of California should also be the subject of experimental study."

Certainly the growing importance of the beet sugar industry in this country and the wide field for its expansion should justify Congress in making provision for the experiment stations suggested in the report of the department of experts.

When we reflect that during the calendar year 1893 we imported 543,288,489 pounds of beet sugar valued at \$17,331,143, and 3,223,666,073 pounds of cane sugar, valued at \$104,443,619, besides molasses to the value of \$1,976,916, or a total value for sugar and molasses of \$123,741,678, it becomes evident that the field in front of the intelligent beet farmer is a wide one.

At this writing the proposed changes in the McKinley tariff have not been consummated, and the outcome of the debates in Congress is somewhat uncertain. If the sugar bounty law should be repealed without offering the sugar producers something in the way of an equivalent, it would greatly antagonize the cane growers of Louisiana and Florida, as well as the beet producers in all sections of the Union. This would endanger the party in power and possibly lead to future legislation of a permanently protective character in this direction. In any event, however, the beet industry will thrive in many places, and the production of sugar from beet roots in this country must become an established industry.

EXPERIMENTAL FARMING IN UTAH.

Rotation of Crops, Sub-Irrigation and Tillage
Tests by Agricultural College.

BY PRESIDENT J. W. SANBORN.

I.

THE experiment station farm of the Agricultural College of Utah includes 83 acres of land devoted to common farm operations and to investigation. It is situated on upper bench soil a foot and a half beneath the surface, having a compact sub-soil of one to two feet in thickness that is impenetrable by the plow. Beneath this it is very gravelly.

ROTATION OF CROPS.

Twenty-four acres of it are laid out to rotation of crops in the following order: Corn, oats, clover, wheat, timothy, timothy. This rotation is based upon the philosophy recognized by expert farmers as applicable to rotation, the alternation of narrow and broad-leaved plants, deep and shallow rooted plants, plants of unlike feeding capacity, unlike dates of maturity, unlike leaf development, unlike root development, unlike composition of stock feeding, so dividing the crops as to extend operations over the varying seasons of the year. This farm is regarded as very poor in quality, yet the crops of last year were over 40 bushels of wheat, oats about 50, while the

timothy and corn were good fair crops. The soil is not very well adapted to timothy, and the cold nights make corn less productive than in the Mississippi valley.

EXPERIMENTS WITH CROPS.

Twenty-two acres were given to pasture and sowed to varieties of grass and clover, namely: Lucerne, white clover, timothy, red top, English rye grass, Kentucky blue grass, orchard grass, meadow foxtail, meadow fescue. This produced on our dry upland soil under irrigation a luxuriant growth, at one time carrying 45 head of stock and a few sheep and at no time having less than 34 upon it. A test of each of these varieties separately shows that for equal area the mixed pasture grass surpassed Lucerne or any other single variety. There was little difference in grazing value between timothy, tall oat grass, English rye grass or meadow fescue. Meadow foxtail and blue grass proved excellent grazing grasses. The rest of the farm is given over to plat experiments. On the section devoted to varieties of grass we found that for the arid region meadow foxtail (*alopecurus pratensis*) promises to have great value because it heads in May and will produce one good crop for grazing and a fair crop for cutting before the effect of spring rains is lost. The same may be said of Sanfoin and of Lucerne. On this farm sheep's fescue has surpassed its record at other points in giving a dense and successful crop under irrigation.

A section is devoted to varieties of corn, wheat, oats and barley. The result of such experiments I deem of very little interest, except for the immediate locality of their test.

SUB-IRRIGATION.

Some 80 to 90 plats are devoted to sub-irrigation *versus* surface irrigation; to irrigating every three days or multiple of three days until reaching 18 days apart, the same amount of water being used for the season. Irrigating with different amounts of water from one foot to four feet for the season; also fall and spring *versus* spring irrigation. Irrigating early and late during the season to note the influence of an extended period of irrigation, and to other inquiries. Sub-irrigation has proven a failure for farm crops for the reason that the lateral movement of water is too slow to equal evaporation from leaves of plants and from the soil. One and one-half feet of water on our open soil has proven as efficient as a larger quantity for wheat, although double this amount is required for timothy. On our open soil irrigation every 12 days seems to be required for maximum quantity of wheat, but not so often for timothy, as the sward furnished by timothy seems to hold the water better. Application of water in the fall and again in the spring is found advantageous, as the soil stores the water and retains it until spring,

thereby holding water that would be running to waste in the rivers.

EXPERIMENTS IN TILLAGE.

A large number of plats have been devoted to tillage of corn, wheat, potatoes, and include tillage at varying depths, and from no tillage to excessive tillage of the ground and preparation of crops, also plowing from four to ten inches deep, increasing the depth two inches at each change. We do not find that excessive tillage is profitable, not increasing the crop. Deep plowing has not affected the crop. Hoeing of wheat has been unsuccessful. Deep tillage of corn has been unprofitable. We find that hilling of corn, or checking, rowing and hilling is equally as effective as plat cultivation, enabling us to keep the weeds down without the aid of man or hoe.

SIMPLE EARTHEN DAMS.

Practical Suggestions for Farmers Building Small Reservoirs for Irrigation.

BY SAMUEL FORTIER.

I.

The object of this paper is to give a few hints which may aid farmers when engaged on earthen dams for irrigation.

1. All materials used in earthen dams pack better when moistened. This is particularly true when the material consists of a series of particles ranging from very fine to coarse. When water is applied a mortar is made of the finer particles, into which the larger grains are imbedded somewhat as the gravel or broken rock is in cement concrete.

2. No earthen dam will long resist the action of even a small volume of water flowing over its top, so that ample provision must be made to by-pass the flood water.

3. It is usually difficult to obtain a water-right between the original surface and the embankment, and as planks are grooved and tongued to make righter joints in lumber, so it is good practice to dig a trench beneath the embankment and fill it with puddled borrowed material.

4. Two things are essential in all such structures, viz.: An impervious coating and sufficient weight to resist the horizontal thrust of the pressure of the water.

5. Means must be provided to draw off the water when required for use. This is effected by a box, tunnel in rock, stone, culvert or pipe, with the area way of whatever is used stopped by a movable gate.

6. Water under pressure, unless acted upon by other forces, tends to flow in straight lines; and, other things being equal, that construction is the best which causes the escaping water to turn the most angles.

7. Earthen banks will not long resist the action of waves.

8. Every precaution should be taken to ensure thoroughness in the building, as a leak once formed can seldom be stopped.

SUGGESTIONS IN BUILDING SMALL RESERVOIRS.

The objects for which water is stored and the various conditions which exist in each case differ so widely that it is impossible to lay down precise rules. Speaking generally, however, one of the first things to be done after the site is secured is to make provision to draw off the water. Wooden boxes or cribs of timber, although sometimes used, are not to be recommended from the fact that they soon decay, and are extremely difficult to replace, are a source of weakness to the reservoir and do not admit of easily inserting a gate which can be freely operated. Stone culverts, laid in cement, are costly and substantial as a rule but require a special gate which may give trouble. Piping, of which there are several kinds in the market, is perhaps the most suitable, and by its use one can purchase the standard low-pressure water valves, such as are in use in the city water works, that are guaranteed to give satisfaction. The following are some of the kinds of water piping, together with the approximate prices per linear foot, at principal cities in the arid region, for 12 inches interior diameter:

Cast iron piping, in lengths of 12 ft. over all, lead joints. . .	\$1.60
Kalamain piping, in lengths of from 15 to 20 ft., lead joints..	1.60
Wyckoff piping, bored wood with spiral flat bands.....	
Wrought iron or steel riveted piping, No. 14 B gauge in joints of about three feet in length, riveted on lead joints	1.30
Spiral weld steel tubing, cast iron joints with lead.....	
Spiral iron or steel riveted piping, iron joints with lead	
Redwood stave piping (Allen patent) steel round bands, built continuous in the trench.....	.70

Valves may be ordered in more than a score of different places to fit into any one of the above kinds of piping. In most makes one can order valves with sockets for a long rod, which would be used on the inside of the reservoirs, and of sufficient length to reach above high water where a hand wheel is attached. It is much safer to place all valves or stop gates near the inner end of the piping. Where water free of sediment is wanted, as for city use, the outlet pipe is placed two or more feet above the bottom, with a drain pipe at the lowest point to flush out the sediment, but for irrigation it may be placed on the bottom. In laying the pipe care must be taken to provide a safe and continuous bearing beneath it, otherwise the load imposed by the earth above will cause portions to settle, and so loosen the joints.

It is necessary, too, to dig one or more cross trenches from the pipe and pack them full of cement concrete, clay, or good earthen puddle, bringing the

same up two or more feet above the pipe so as to arrest any leakage along the outlet pipe. The surface upon which embankments are to rest should be plowed and the roots of brush and weeds removed to the outer toe of the slope, after which the ground is again plowed and a trench dug along the center of each proposed embankment. When this much is done water should be applied. The writer considers the abundant use of water of prime importance in all works of this nature. Usually it can be conveyed to the site through a flume or pipe, and made to discharge at a height equal to the top of the embankment when finished.

(Concluded next month.)

HOW MUCH WATER PER ACRE.

The Varying Estimates for Different Crops and Localities.—Need of Experiments.

By H. V. HINCKLEY,

Consulting Engineer of the Irrigation Commission of Kansas.

At the Salina Inter-State Irrigation convention I assumed, as a safe *average* duty for water in Kansas, 100 acres per cubic foot per second (second foot) continuous flow. I was at once reminded by an engineer from western Kansas that we should not expect a duty of over 55 or 60 acres.

In a report to an eastern bondholder in a Kansas canal I estimated the *economical* duty for water on the higher lands of western Kansas to be 300 acres for a continuous flow. I have since been confronted with a paper read at the Los Angeles Inter-National Congress by Chas. W. Irish, chief of the U. S. Irrigation Inquiry (a trained hydrographic and civil engineer of nearly forty years' experience), in which he names a duty of 56 acres and says that this average is so thoroughly proven that it is not safe to vary from it, except where there is rain during the growing period.

The published authorities (?) give duties ranging from 50 to 6,000 acres, showing only the extreme indifference in the application of the water or in the compilation of the results, for no such difference can be attributed to the soils, crops or climates of the arid districts.

I am glad to note two recent attempts to determine the actual duty of water. L. P. Maxwell, state engineer of Colorado, has had the water measured as used by the numerous irrigators of five of the large irrigation districts of Colorado and, in report for 1889-90, gives duties of from 168 to 436 acres per second foot—average 226 acres. Average depth of total water applied, 13 inches. This average depth was determined by dividing the flow *in the stream* by the acreage covered. It consequently covers seep-

age, evaporation and effective irrigation, and the results are computed on a basis of four months' flow, making no use of the water for the other eight months.

The Utah experiment station (J. W. Sanborn, director, Logan, Utah), in bulletin number 26, just issued, gives experiments showing duty of 100 days' flow, to vary with the crops (as it should, of course), from 67 to 660 acres per second foot, farm measurement. Average duty, 256 acres and, at the same time, average depth of water applied, 16.4 inches.

These later results fully confirm my predictions, and warrant, in my opinion at least, the assumption of 300 acres as the duty of water intelligently conserved and economically applied to such Kansas soils as are not too sandy. Where ample reservoirs are practicable, the duty can be doubled. But we need more light. We want to know the most profitable depth and duty of water for each crop, potatoes, alfalfa, etc., on the bottoms and on the uplands; also the most profitable frequency of application. The third annual report of the Utah station gives valuable information on this point, but we need experiments of our own.

A WINDMILL IRRIGATOR.

Describes His Plant and How to Make Simple Reservoirs.

A bright Nebraska farmer writes as follows: "I have a wind power plant run by a 14-foot wheel, with an 8-inch pump that throws 4,400 barrels per day in a medium wind. I have two reservoirs, one 60x150 and one 80x150 feet. With this plant I have watered from ten to fifteen acres, and it can be managed so as to water still more by using and applying the water to some of the land during the winter season. It is necessary to use reservoirs so as to have a larger volume of water whenever you irrigate. By this means you have more pressure and can water more land at one time and do it quickly.

HOW HE BUILDS RESERVOIRS.

"To build reservoirs take from the inside of the dimensions that you wish to put into the reservoir the earth to make your banks with, by plowing and scraping it up from your bank, and by so doing you spoil no land on the outside. Two men and a team can make a reservoir 100x100 feet in eight or ten days or less time. The Gause pump that I am using can be used in an open well or with drive points.

"To make your reservoir hold when you begin to pump water into it commence tramping with horses as fast as the water covers the bottom of the pond until you get it into a loblolly of mud two or three inches deep, and this will then settle into the pores of the ground and stop very nearly all the seepage. Do

not put manure or straw into the bottom of the pond if you ever expect to stock it with fish, as they will surely die.

"A plant like mine, or similar, with reservoirs, pumps, etc., complete, ought not to cost over \$250, counting pay for the farmer's labor that he does himself on the plant. I am lifting the water seventeen feet. This pump will raise the water twenty-five feet from the valve successfully.

HOW HE IRRIGATES.

"In irrigating a great many kinds of fruit trees, berries, and in fact all small fruits, use furrows or small ditches instead of flooding the land, and by so doing save at least one-third of the water that it would otherwise take to flood the land. I have eight acres in fruit and in the last three years I have always had enough water to flood this orchard. Where there is a sufficient supply of water underneath and you do not have to go too deep for it, say twenty to thirty feet, I would advise the use of points instead of digging open wells. Where a man is gardening, or wishes to grow an orchard of ten acres, one of these plants will pay for itself in one dry season, and the farmer who has a plant of this kind is always sure of vegetables and berries for his own family use, and I consider this one of the most essential things to the farmer, for in any country to make true farming a success the farmer must grow his own vegetables and fruit for home use."

KANSAS AGRICULTURE.

The report of the Kansas Board of Agriculture for the quarter just ended is completed and in the hands of the printer. It contains the interesting addresses delivered at the Board's annual meeting in January and the valuable discussions they elicited, along with numerous instructive articles pertaining to Kansas and its conditions, which are likely to be of decided encouragement not only to residents within the State, but to all people outside who either directly or indirectly have interest in its welfare and advancement. Besides the foregoing, it contains a painstaking digest of detailed replies to carefully prepared lists of questions sent to about 600 reputable, experienced correspondents, chiefly farmers, who were instructed to make none but "careful, unbiased answers" upon crop, fruit, live-stock and soil conditions as they were March 31st. This report can be had by addressing F. D. Coburn, Secretary, Capitol Building, Topeka, Kansas.

Georgia has established a bureau of immigration and agents are at work at various points in the State to induce settlers to move to that State. Large sections of this commonwealth are to be devoted to fruit raising.

BRIEF NOTES.

Clean cultivation is the wise method for conducting a farm.

Stir the soil to conserve moisture and promote plant growth, as well as to kill weeds.

Storage rooms out of doors for farm tools are cheap in the first instance, but most costly in the final reckoning.

Nitrate of soda can be used with benefit on all crops. It is immediately available and should, therefore, be only employed in connection with plants in an active stage of growth.

There is far too little mulching done. Trees and garden crops are given a most favorable opportunity for attaining the highest perfection when their roots are covered with a thick mat of hay, leaves or other suitable material.

The "weather crank" really dates back a long way. It is said that the first person in the United States to incur the odium attachable to the name was one Dr. Lining, of Charleston, S. C., who began keeping a record of temperature in 1738, and in 1742 began to measure the rainfall.

From this modest beginning has grown up the modern weather service which has proven of incalculable benefit, and is gaining in favor year by year. At the present time reports are received by the Government from more than two thousand stations every day, and the results of these reports are embodied in the bulletins issued each day and widely distributed.

Often the men who prove themselves to be the true benefactors of the race are but little rewarded, nor long remembered. Probably but few people ever heard of the man who, by dint of experiment, by accident or otherwise, it matters little now, perhaps, developed the Concord grape. It is now forty years since that grape appeared, and it is not too much to say that it has been a potent factor in the civilization and well-being of the American people. If its money value could be computed it would be safe to say that a billion dollars would not compensate for its annihilation from the long list of delicious American fruits.

A new town site has been laid out in the center of the future Big Horn county, Wyoming.

Kansas' greatest apple grower will add 25,000 trees to his Leavenworth county plantation next spring.

Near Eddy, N. M., a colony of sixty families from St. Louis, Mo., will settle on Pecos valley lands next month.

The Irrigation Loan and Investment Company, of Hutchinson, Kan., has been incorporated. Capital, \$50,000.

HORTICULTURE BY IRRIGATION.

MORE CULTIVATION AND LESS WATER.

IN the care of an irrigated orchard it is a very easy matter to use too much water. Experience in California and elsewhere has shown that the average irrigator is prone to the excessive use of water in his orchard. For this reason there has grown up the belief in some quarters that irrigated fruit is inferior in quality to that produced without the aid of artificial watering. But further experience by careful growers has shown conclusively that lack of quality in fruit does not come from artificial watering, but from too much water.

Particularly is this shown beyond question in the prune orchard of some parts of California. The prune when not grown under the influence of too much moisture will yield one pound of cured fruit for about two pounds or less of fruit as it comes from the tree. But if irrigated excessively it often requires three pounds or more to make one pound of cured fruit of an inferior quality. On the contrary, if irrigated just enough to keep the tree in vigorous growth and to mature a heavy load of fruit, it is found that not only is the quality of the fruit equal, but the yield of cured fruit very much greater. It is simply a question of using a proper amount of irrigating water—not an excess of it. It is also found by the daily practical experience of orange growers and others in Florida and California that frequent and shallow cultivation of the surface soil so conserves the moisture that a very much smaller quantity of irrigating water or rainfall will suffice to mature a crop of fruit, than if the soil has not been thus carefully and scientifically prepared. By thus cultivating the soil, as soon after irrigation as the ground reaches a fit condition, and before it becomes hard and lumpy, the moisture may be retained very much longer than if not so cultivated, or if the surface be allowed to become and remain uneven and cloddy.

A knowledge of these facts leads the best cultivators at Riverside and other orange growing centers, not only to cultivate carefully after each irrigation, but also to pass a roller or smoother over the orchard with a view to making the group as even as possible, and wholly free from clods and lumps. Shallow cultivation with fine toothed implements should be done probably as often as every ten days between irrigations, in which case, it will be found, if properly done, that the irrigations may be made less frequent. The top soil must, however, be well pulverized, and

if it be as fine and dry as flour no harm will be done. Indeed, it is all the better as a mulch, for little or no evaporation can take place through this non-convective covering of dust. All this is easily explained. Evaporation takes place from the surface of the ground only after the moisture is brought up from below by the action of capillary attraction. The capillary tubes which make this action possible are formed by the relative positions which the coarser particles of earth assume, but which frequent cultivation and pulverizing break up and destroy. Thus the moisture that is placed about the trees by irrigation or otherwise is mostly preserved in the ground, except such as is taken up by the roots and transpired into the air through the leaves. It must be evident to all that by cutting off evaporation wholly or largely by means of a "mulch blanket" of fine, dry earth made by careful and frequent cultivation with approved implements, the quantity of water required for the proper growth and maturing of a crop may be very much lessened.

These suggestions have a cash value to all fruit growers, whether in the arid region or not. If not in the arid region fruit growers are nevertheless subject to periodical drouths which, by pursuing the course here prescribed, may be rendered partially or wholly nugatory, and a good crop produced in spite of them. Advanced fruit growers in many parts of the country know this by experience, and need no arguments to convince them. To fruit growers in irrigable districts the system of cultivation here suggested will save immediate cash outlays when it comes time for the monthly collection of water bills. To all fruit growers it will, if adhered to, be beneficial and put money into their pockets through larger crops of better fruit which their trees will produce under such careful and intelligent tillage as is here outlined.

PECAN CULTURE.

Perhaps the most cosmopolitan of the nut trees largely planted for profit is the pecan. It grows from Texas to Illinois, and from Florida to Puget sound. Hundreds of acres are found growing wild in Texas and some other States, and larger incomes are frequently drawn from these native pecan groves than from the cattle ranches or surrounding cultivated farms. The tree being a species of hickory, the timber is valuable as well as the nut, and brings a high price for certain purposes.

Several varieties are known in a number of States, but the larger and thinner shelled varieties are most in favor for cultivation. Pecan culture has assumed considerable proportions in a number of the Gulf States, as well as in some places along the Pacific coast. Like the hickory, the pecan thrives best in rich, moist land along streams or in fertile valleys. Efforts have lately been made to propagate trees from the largest and finest nuts to be found, and a result is that some very valuable trees have been produced bearing nuts large, thin shelled and full of the richest and sweetest meat. Mistakes are often made in planting the trees too near together. Indeed, this is a common error in the planting of any variety of trees in orchards. At this time, it is not positively known by experiment whether the pecan is seriously injured or not by cutting off wholly or partly its tap root at the time of transplanting. Some growers allege that it is better to remove the tap root and thus allow a wider branching of the root system, while others contend that the removal of the tap root sounds the death knell to the tree as a bearer of nuts in paying quantities. While some planters assert that the tree will come true to seed, others allege stoutly that in order to propagate choice fruit, the trees must be grafted. In any event, so strong is the faith of each school that while the one plants nuts in the places designed for the trees to grow to form an orchard, the other devotes much care to grafting favorite varieties into trees previously transplanted from the nursery, or grown *in situ* from the seed. In some places in Florida, fine pecan groves have been made by grafting choice varieties upon the native hickory, which may be found growing in large "patches" among the scrub oaks in some of the very sandy regions of that State. By thinning out the trees sufficiently, an early and profitable nut orchard may be thus established at small cost.

The process is similar to that by which some of the best orange groves in Florida were established by merely grafting fine varieties upon the wild orange found growing in great number in the hammocks. While such groves have the disadvantage of irregularity in the distances between the trees, yet there is the indisputable advantage of not having to transplant the trees. Some have made pecan orchards by planting nuts where the trees were to stand and subsequently grafting the trees when two years old, with their favorite varieties. Pecan trees should never be planted less than 35 or 40 feet apart, for the spreading habit of the tree will soon enable it to fill the spaces if the soil and cultivation are of a suitable character. Ordinarily the pecan tree is not an early bearer, and many kinds will delay profitable returns for half a score of years. Some allege that the time to reach a profitable bearing stage may be shortened

by budding or grafting as above suggested rather than to allow the tree to grow as a seedling. This rule is well known to hold good with many varieties of fruit also. Pecans to sell best in market should be large, thin shelled and meaty, and a very wide difference in prices is shown in the various markets, corresponding with these conditions.

If trees are planted at 35 to 40 feet apart, it will be found easy to cultivate other profitable crops between the rows for a number of years. Wherever irrigation is possible, any one of a considerable number of crops may be grown as an inter-culture among the nut trees. Corn, beans, grapes, alfalfa, cabbage, onions, berries, or other crops may be grown, thus fully utilizing the ground until the bearing stage of the nut trees shall be reached. Harvesting pecans is a simple process. The nuts are let alone until they fall to the ground, when they are gathered in sacks and sent to market without further preparation.

A UTAH ORCHARDIST ON SPRAYING.

J. C. Lemon, a notably successful farmer and fruit-grower of Ferron, Utah, writes THE AGE of his method of spraying trees as follows:

"I irrigate my trees as soon as possible in the spring, so as to keep back the early blossoming; then when the trees do start, they do so with more vitality and vigor. I prefer early irrigation, so as to get as much early growth in first part of the season, then the trees are in good condition for fall, provided they are not started in September to make a second growth in a season. This is the cause of some trees dying at the tops. Water trees late in the fall and early in the spring. I use the F. E. Meyers spray pump. I use or prefer Paris green for spraying apples, although London purple is good. I spray the first time as soon as the trees are in full bloom, and again in about ten days, but if it should rain inside of a day or two after I have sprayed, I spray again. I made my spray a little bit stronger than this formula: one pound of Paris green to about 150 gallons of water. I have never had any worms on my trees or in my apples, but I thought an ounce of prevention better than a pound of cure. I always manure and cultivate thoroughly, delve between the trees and place all the bones and refuse of a like character at the roots of my trees, and the result is good, vigorous, healthy trees that bear an abundance of apples, that I will place in competition with any in the United States for quality, color and flavor. I have never had any pear or plum leaf blight, but should anything of the kind occur I will fight it with a formula I have for the purpose."

The secretary of the interior has ordered a re-survey of the Las Vegas land grant in New Mexico.

PULSE OF THE IRRIGATION INDUSTRY.

IRRIGATION IN THE NORTHWEST.

IRRIGATION is rapidly gaining ground among the intelligent farmers of the Pacific Northwest. In Walla Walla county, Washington, good progress was made last year in the construction of irrigating canals. A list has been published showing that what is known locally as the Willis ditch is 14 miles long, and will water 5,000 acres. The Lowden ditch is also 14 miles in length, but will water 20,000 acres. Two others, one 3 miles long and the other $3\frac{1}{2}$ miles, will water 20,000 acres more, while the Hawley ditch, 15 miles in length will water 10,000 acres, and the Wolf ditch another 10,000 acres. Thus, omitting the Wolf ditch whose length is not given, the length of ditch in one county for one year's work is about 50 miles, and the amount of land thus benefited 65,000 acres. It is impossible to estimate the vast and far reaching importance of such enterprise in the arid regions. Evidently the men of Walla Walla county have a proper perception of the necessary means to develop the agricultural resources of their section.

But other sections of the State are also forging ahead with commendable vigor, and the Yakima valley is full of great possibilities under the irrigation enterprises developing so promisingly in that remarkable region. Small farms, which are gradually supplanting the great ranches in all irrigated sections, will eventually do for Washington and neighboring States what they have already done for California and Colorado. Special attention is being given to the production of alfalfa in some parts of Washington, and with unlimited facilities for procuring water, that State is destined soon to stand beside the best in the yield of dairy products and fine stock. It has been demonstrated that among the very best butter and milk producing plants is alfalfa, which grows luxuriantly on the irrigated lands of Washington as well as the other Pacific States. Large exports of dairy produce should therefore soon be expected from that State, although up to the present time the home demand has been in advance of the supply. Late reports denote a spirit of commendable activity in irrigation matters elsewhere in Washington, as well as in the places above referred to. At Ellensburg, in Kittitas county, public spirited citizens are reported to have subscribed a fund to pay the expense of surveys, estimates, etc., to extend the system already in operation, and it is expected to add at least 5,000 acres to the area to be watered. The

Prosser Falls district is also putting forth efforts and some good work has been accomplished. Analyses of soils in nearly all of the sections here under notice have been made and the fact developed that they are unusually rich in some of the essential elements of plant growth. Especially has it been found by Professor Hilyard and others that the soils of arid Washington are rich in potash. This is a very important feature which THE IRRIGATION AGE will no doubt announce for the first time to many land owners of that rapidly growing State. Phosphoric acid, too, is present in considerable amount in these soils, which, taken in connection with the favorable climatic conditions obtaining, must render the irrigated lands of Washington especially attractive to settlers.

A GREAT NEBRASKA CANAL.

The people of Holt county, Nebraska, are very much in earnest on the subject of irrigation at present.

The Niobrara River Irrigation and Power Company has been organized with headquarters at O'Neill. It has an authorized capital stock of \$2,500,000, and the incorporators are Messrs. A. U. Morris, J. L. McDonald, H. A. Allen, R. R. Dickson, J. P. Mann, O. F. Biglin, F. V. Golden, G. C. Hazelet, Neil Brennan and J. A. Testman. The purpose of the company is to construct a main ditch from the Niobrara river, in Sheridan county, through Cherry, Brown, Rock, Holt, and perhaps Knox counties, with lateral ditches furnishing irrigation for the soil and power for the numerous manufactories that will spring up along the way.

The work of construction has actually been begun, though only a preliminary survey has yet been made. A corps of engineers will be put in the field in a few days, and the work will be vigorously prosecuted. It is expected that it will take about four months to complete the survey and make the necessary maps and profiles, but in the meantime a force of men will be actually engaged in the work of construction.

If the reader will take his map of Nebraska and look at a point on the Niobrara river just south of Rushville, in Sheridan county, he will see where it is proposed that this ditch shall begin. It will then take an easterly direction until it strikes the Snake river, about the western boundary of Cherry county. It is expected to follow the bed of this stream some twenty or thirty miles, when it will leave it, and, after an eastwardly course, will intersect Bordman's creek,

follow its bed for about the same distance, again cut across the country to Gordon creek, and from there connect with the big chain of lakes in the eastern portion of Cherry county. It is claimed that with comparatively little work these lakes can be turned into a huge reservoir, where the water can be stored for use at such times as may be desired. From this reservoir it is then proposed to use the bed of Plum creek to Johnstown, where the ditch will cross the Elkhorn railroad and proceed eastward along the divide to O'Neill, and then northeasterly to a confluence with the Niobrara or Missouri.

It is proposed that the ditch will be about 70 feet wide at the bottom and 10 feet deep, and that it will furnish sufficient water for irrigating 400,000 acres of land during the four months when irrigation is most needed, viz: July, August, September and October.

From the main ditch laterals will be constructed on the divides between each of the main branches of the Niobrara, irrigating toward the branches and carrying the surplus water into the Niobrara.

GOVERNOR MURRAY'S ENTERPRISE.

The Capabilities of the San Diego County.—Where it is Located.

A large irrigation enterprise is reported from San Diego county, California. The Pine Valley Water and Land Company, promoted by Gen. Eli H. Murray and others, has lately acquired a reservoir site in Pine valley, with a capacity to store eight billion gallons of water, or one-third more than the capacity of the Sweetwater reservoir in the same county. In order to impound this large amount of water a dam 150 feet in height will need to be erected, and it is reported the work of construction will not be long postponed. The climatic conditions of the San Diego region are conducive to health and to the enjoyment of life in the open air during a large part of the year. And when fully understood by those desiring a change of residence, a large influx of well-to-do and otherwise desirable people will almost certainly result from an extension of the splendid systems of irrigation which already exist in the county.

Although the annual rainfall at San Diego has averaged less than ten inches during the past forty years, yet back from the coast among the mountains the rainfall is very much greater, and is able no doubt to supply many reservoirs of large capacity whenever they shall have been located and adequately dammed.

It is well known that under irrigation the soil of San Diego county may be made to produce nearly everything that enters into the food supplies of the human family. Grains of all the staple varieties, alfalfa and other forage plants, fruits of all kinds, from apples to oranges and lemons, are fully at home

in the environment found in the proximity of San Diego bay. What is quite remarkable for any country is that along the bay region the finest oranges and lemons as well as the most delicious apples may be grown on the same ground. It is rare that this condition is found anywhere; for whereas the citrus fruits delight in warm sunshine for a good part of the year, the apple requires a cooler period in which to prepare for the following crop. But in the region of San Diego bay the needful conditions appear to meet on the same ground and the result is an astonishing condition of production. It appears to be neutral ground whereon meet and thrive together the subtropical fruits and those of the colder latitudes as well.

The products of the bay region about San Diego, now on exhibition at the Midwinter Fair at San Francisco, challenge the admiration of all. They range in point of latitude from Guatemala to Nova Scotia. The delicious pine apples of Toboga island in the bay of Panama are flanked on either side by the lemons of Paradise valley and the Newtown pippins of the Julian district.

General Greeley, of the United States Signal Service, has stated that the most equable climate in the United States is to be found in the region of San Diego bay in Southern California. It is certain that with the development of the irrigation enterprises now under way and projected in the southern sections of California, an impetus will be given to colony-building under those balmy skies, which must result in lasting benefit to the country and to the individuals who successfully carry out the plans now maturing for such colonial establishments. Every new scheme having the honest purpose to conserve and distribute more equitably the natural rainfall of any part of the arid region should be welcomed and encouraged; for while some of these undertakings may fail, yet their inception is born of a praiseworthy effort to cause two or more blades of grass to grow where none grow before.

AVAILABLE PUBLIC REPORTS.

A subscriber asks for a list of Government reports on irrigation that can be obtained by the public. The reports of the Geological Survey are as follows:

Reports on Irrigation, prepared mainly by A. H. Thompson, H. M. Wilson and F. H. Newell.

First Annual Report of the United States Irrigation Survey. Published as Part 2, Irrigation, of the Tenth Annual Report of the U. S. Geological Survey. 132 Pages. Preliminary.

Second Annual Report of the United States Irrigation Survey. Published as Part 2, Irrigation, of the Eleventh Annual Report of the U. S. Geological Survey. 394 pages, 30 plates, 4 figures. (Water-supply, surveys of reservoirs, and bibliography of irrigation.)

Third Annual Report of the United States Irrigation Survey. Published as Part 2, Irrigation, of the Twelfth Annual Report of

the U. S. Geological Survey. 576 pages, 93 plates, 190 figures. (Reservoir sites, hydrography, and irrigation in India.)

Fourth volume, published as Part 3, Irrigation, of the Thirtieth Annual Report of the U. S. Geographical Survey. 498 pages, 77 plates, 112 figures. This report contains an article upon Water Supply for Irrigation, a discussion of American Irrigation Engineering, on Engineering Results of the Irrigation Survey, and a Report upon the Construction of Topographic Maps and the Selection of Reservoir Sites.

The reports of the census bureau are as follows:

Reports prepared by F. H. Newell:

Bulletin No. 35,	Irrigation in Arizona.
" " 60,	" " New Mexico.
" " 85,	" " Utah.
" " 107,	" " Wyoming.
" " 153,	" " Montana.
" " 157,	" " Idaho.
" " 163,	" " Nevada.
" " 178,	" " Oregon.
" " 193,	Artesian Wells for Irrigation.
" " 198,	Irrigation in Washington.

Extra Bulletin No. 23, Irrigation in Western United States, contains condensed statistics of areas, values, and water supply, illustrated by four plates, being in size and general arrangement the first part of the final report.

Final report, now in the hands of the printer, to form a separate monograph, and also to appear as part of the Eleventh Census Report of Agriculture. This consists of about 900 quarto pages, with numerous maps and illustrations, and contains a discussion of the systems of irrigation in each county of the States and Territories forming the arid region.

GENERAL NOTES:

Arizona.—Artesian water has been struck in Cochise county, A. T., by a man named McRae. The flow is 21,000 gallons in 24 hours. In addition to the value of the water, McRae will get \$2,000 reward offered by the Supervisors for a running well not more than 500 feet deep.

California.—The new Lee lake dam has been inspected and pronounced good work. The Santa Ysabel Water Company, of Nuevo, is about to incorporate. The immense San Joaquin Rancho, in Orange county, is being carved up and sold in small quantities. It is said that the Flume Company and the San Diego Water Company may consolidate into one corporation. Each company has a capital of about \$1,000,000. An evidence of the rapid growth of Riverside county is to be found in the fact that eight school districts are about to vote for bonds for the erection of larger school buildings. Preliminary to being re-organized upon an improved basis, the Ojai Valley Water Company has petitioned to be allowed to disincorporate. A ranch in Pine Valley, San Diego county, has been sold to the Pine Valley Consolidated Water and Land Company, together with the well-known Pine Valley reservoir site and water rights. Surveys have shown that a perfect site exists for a dam capable of holding 8,000,000 gallons of water, 2,000,000 more than the Sweet-water reservoir. I. E. Doty has been awarded contract for constructing an irrigation system at Escondido.

Colorado.—The Fort Morgan Reservoir and Irrigation Company has been incorporated with a capital stock of \$150,000. Twenty names appeared on the application as incorporators. Morgan county is up to the standard in farming and is irrigated fairly well, but we would suggest that the farmers there pay a little more attention to the riddance of the grasshopper this summer and thus reap the entire benefits of their crops. The Hallett Ditch Company, Glenwood Springs, owning 29 miles of canal, will expend \$25,000 in improvements.

Idaho.—The Ridenbaugh canal management have completed the new headgate in the north lateral, nearly opposite Boise, and are now engaged in putting a double headgate at the head of the Nampa lateral, about three miles west of this city. Ninety feet of the flume across Indian creek was wrecked by the flood. Carpenters are now at work preparing to replace it. The Fruitdale colony at Mountain Home have a force of fifty men at work, planting prune trees. Prosser Falls has a unique advertisement in the shape of a big sign board thirty feet long by ten feet high, standing so that it can be seen from the railroad, and upon it the following, in big black letters, appears: "Thus saith the Lord: Make this valley full of ditches. Ye shall not see rain, neither shall ye see mud; yet the valley shall be filled with water, that ye, your animals and your beasts may drink.—II Kings, iii, 16."

Nebraska.—The Culbertson canal, which was started in the spring of 1890, is now nearing completion to the Blackwood creek. It will cover, with the proposed extension, thirty thousand acres of land. It belongs to the Culbertson Irrigating and Water Power Company, which is composed of W. L. Matson, of the Security Company of Hartford, Banker Abbe, of that city, General Manager Holdrege, of the B. and M. Railroad Company, and Lawyer F. I. Foss, of Crete, Nebraska. No expense or pains has been spared to make it one of the best ditches in the West, and in this respect they have succeeded to an admirable degree. Quite a large acreage will be irrigated this year. The canal does not depend upon any underflow for water; the Frenchman river supplies water of a volume of three hundred cubic feet per second, which is perpetual and never-failing. The company enjoys a first right to the water of this river. Every indication points towards a great measure of success in this locality and results are expected which will astonish the older irrigated communities. Mr. C. C. Hubbard, the general manager, is pushing things and proposes to have a canal second to none in the semi-arid region. The proposition to issue \$60,000 worth of bonds to widen the Kearney canal and increase the water power, carried at the election held recently at Kearney, Neb., by a majority of 984 votes. The vote was practically unanimous. "Buffalo Bill" Cody has commenced work on his private irrigating ditch near North Platte. Engineer Kittell has completed his work on the Nine Mile canal, which is now being pushed forward rapidly. The company has ordered Blackhills lumber from Alliance, which is now being hauled over. The headgate will require about 22,000 feet of lumber, besides a proportionate amount of piling. Some of the people living in the counties of Deuel, Cheyenne, Banner, Kimball, Scott's Bluffs, Dover, Sioux, Box Butte and Sheridan, in the western part of Nebraska, want to be annexed to Wyoming in order that they may be able to take advantage of our laws with regard to irrigation. The Nebraska territory mentioned is arid, and the farmers complain that the authorities of that State do not look after their interests as they should.

South Dakota.—South Dakota is going into irrigation on the artesian well basis. There was held at Huron recently a convention of artesian irrigators and the sentiment of the convention was pronounced in favor of sinking more artesian wells. Although irrigation is not absolutely essential to secure crops, it has been demonstrated that irrigation insures a more abundant yield and secures protection against loss by hot winds. A permanent organization was perfected and a committee was appointed to prepare an address to the people of South Dakota on the subject of artesian wells and irrigation. Plans were outlined to secure State and National aid in perfecting a practical system of irrigation for South Dakota and for filling low places, lake beds and streams with water from artesian wells.

Texas.—The known length and width of the so-called artesian water belt of Texas is growing constantly, and the original ideas which were held in regard to the area of this belt have been materially changed. There now seems to be no absolute cer-

tainty as to where an abundance of artesian water can or cannot be found if a thorough search is made for it by putting down wells. Since the discovery of an abundance of artesian water in McMullen county by the well put down by Dr. J. B. Taylor on his ranch a large number of additional wells are to be drilled in that immediate locality by stockmen and farmers, and that the water will be used for irrigation and stock purposes. . . . The mammoth Miller & Hill irrigation pumping plant on the Nueces river, near Mathis, has just been put in operation. In one hour and twenty minutes after steam was turned on for the first time the river stopped running below the plant, the whole flow of the river having been turned through the immense pump on to the land through properly constructed ditches. The operation of this plant inaugurates a new era for farmers in southwest Texas, who may now profit by the experience of their neighbors. This plant is the first of the kind in the Southwest, and was designed by Engineer Frank L. Taylor, and was constructed by Greathouse & Taylor, and is in every way a success and more than merits the expectations of its projectors.

The success of the above enterprise proves that thousands of acres of land can be irrigated in southwest Texas at but small cost. All that southwest Texas needs to make it the most productive country in the world is plenty of water, and this can easily be had by sinking artesian wells and by utilizing the water in the creeks and rivers. . . . The Rio Grande Dam and Irrigation Company, El Paso, on April 15th will open bids for construction of dams and canals.

Washington.—It is reported that 85,000 acres of land have been reclaimed by ditches near Walla Walla last year, known as follows: The Willis ditch, fourteen miles long, covering 25,000 acres. Frank Lowden's ditch, fifteen miles, will cover 20,000 acres. Lowden's Dry and Mud Creek ditches, each three miles long, covering 20,000 acres. The Hawley ditch, fifteen miles long, and covers 10,000 acres, and the Wallula ditch, which is twenty miles long and covers 10,000 acres. . . . Preparations are now being made to extend the Middle ditch above Ellensburg, Kittitas county, the bonds having been declared legal by the supreme court. This will reclaim about 35,000 acres of rich productive land. . . . Surveys have been completed for an irrigating ditch on the south side of the Wenatchee river, starting at Peshastin creek, and destined to supply water to Wenatchee, Pine Mission and Brown Flats. . . . Reports from irrigation districts in eastern Washington are to the effect that where it formerly took several days to put water the whole length of a ditch, it requires but one day this season. This may be explained from two causes. First, the longer a ditch is used the more the interstices become filled, causing less leakage, and again, the ground is thoroughly soaked with water and will not take up so much. . . . Prosser celebrated the completion of her great irrigation pumping works on the 16th. . . . The prospects for a fruit packing and preserving plant to be started in Tacoma this season are now excellent. The Tacoma Fruit Growers' Association will form a prominent factor through which mutual benefit to its members will be derived. . . . H. K. Owens is interested in surveys that are to be made for an irrigation ditch at Ellensburg. . . . Spokane and Helena capitalists have authorized G. M. McKinney, of North Yakima, to secure right of way for the proposed Wide Hollow ditch, and will give a bond of \$150,000 to have the ditch built in six months. It will irrigate 12,000 acres.

Wyoming.—Two thousand acres of the choicest land on the Fort Fetterman reservation near Douglas, Wyoming, have been located by J. M. Brockway, Alexander Brockway, James A. Brockway, David S. Brockway, Willard Virden, G. W. Dickson, Mrs. Matilda Foggett and Miss Maggie E. Brockway, of Douglas. It is the intention of these people to begin the construction of an irrigating canal from the Platte river to irrigate the lands. The selection comprises some of the finest agricultural land in the State.

Kansas.—The Garden City Irrigating Company are reported to be getting in good shape to handle their properties success-

fully this season. The system is reported prepared to supply water for the coming season, and the company is making contracts for that purpose.

Florida.—P. S. Partridge, of Jacksonville, Florida, has been given a contract at \$2,100 to construct an irrigation system for Greeling, Huling & Sawyer's orange grove.

Mexico.—W. Pierson and President Diaz are discussing the pushing of the Mexican Valley drainage canal to the six-mile tunnel, which is expected to be ready for opening May 5th. The present conference is to devise means by which the \$10,000,000 work may be expedited.

NEW COMPANIES.

Arizona.—The Southwestern Irrigation Co., of Phoenix.

California.—Irrigation Machinery and Manufacturing Co., Los Angeles; \$25,000. April 10. . . . Uras Water and Land Co., San Francisco; \$40,000. April 11. . . . The Sunset Irrigation and Location Co., Los Angeles; incorporated by J. F. Crank, A. E. Pomeroy, F. J. Cooper, John A. Pertle and George P. Adams. Capital stock, \$10,000. . . . The Loomis Fruit Growers' Union, Loomis; incorporated by J. N. Barton, S. C. Laird, H. M. Brandstetter, G. H. Turner and G. G. Lavers. Capital stock, \$10,000. . . . The Elsinore Land and Nursery Co., Elsinore; incorporated by Peter Wall, Clara Wall, Elizabeth Wall, Ida Wall and G. M. Washburn. Capital stock, \$20,000, of which \$18,850 has been subscribed. Organized for the purpose of dealing in water, land and nursery stock, and doing a farming, fruit-growing and nursery business.

Colorado.—The Montezuma Valley Irrigation Co., Cortez; \$700,000. April 11. . . . The Granby Ditch and Reservoir Co., Delta; \$7,000. Operating irrigating ditches, etc. April 16. . . . The Hudson City Ditch Co., Denver; \$100,000. Operating irrigating ditch. April 17. . . . The Fort Morgan Reservoir & Irrigation Co., Fort Morgan; \$150,000. April 14. . . . The Glenwood Orchard & Irrigation Co., Denver; \$200,000; April 5. . . . The Lake Reservoir Co., Denver; incorporated by A. A. Dicker and others; capital stock, \$25,000. . . . The Nauman Lake Reservoir Co., Denver; incorporated by A. A. Dicker, J. G. Benton and E. H. Benton. Capital stock, \$2,000. . . . The Hesperus Town and Improvement Co., Denver; incorporated by A. C. Hunt, Alexander Anderson and Thomas Marshall. Capital stock, \$25,000.

Kansas.—Arkansas Water Power and Irrigating Co., Kendall, incorporated. Capital stock, \$20,000. . . . The Chapman Wind Mill Spring Company, Topeka; incorporated by Thomas C. Gunn and others. Capital stock, \$2,000.

Nebraska.—Middle Loup Valley Irrigation & Canal Co., West Union; \$50,000. April 7.

Missouri.—Mexican Colonization & Land Co., Kansas City; \$2,000. April 13. . . . The Corsicana Valley Water Power and Irrigating Co., Kendall; incorporated by Franklin Wright and others. Capital stock, \$20,000.

Texas.—Milford Artesian Well Co., Milford; \$7,500. Supplying water; April 10. . . . The Corsicana Water Development Co., Corsicana; incorporated by Charles Allyn and others. Capital stock, \$100,000. . . . The American Well and Prospecting Company, Corsicana; contract for sinking three artesian wells for \$30,000. . . . Charles W. Ogden, E. G. Holden and S. N. Johnson, Rockport, are organizing a company to encourage Grape cultivation.

Florida.—A company is being formed at Leesburg to cut a canal, three-quarters of a mile long, between lakes Harris and Griffin.

Washington.—North Seattle Land Co., Seattle; \$100,000. March 31. . . . Oceanside Land Co., Olympia; \$10,000. April 2.

PUBLISHER'S DEPARTMENT.

KERN DELTA COLONIES.—AN OPINION WORTH HAVING.

ONE of the best judges of land values and colonization opportunities in the West is Hon. C. C. Hutchinson, founder of Hutchinson, Kansas. He has devoted a lifetime to the study of these things, and has been notably successful in developing new countries. He recently visited the property of the Kern County Land Company, at Bakersfield, Cal., and there contributed to the local newspaper a statement of his opinions. It will be read with very great interest by thousands of people in the West who have confidence in Mr. Hutchinson's ripe judgment. The following is what he wrote:

THE RICH LANDS OF KERN DELTA.

Editor Californian—SIR: You ask my opinion as to the resources and prospects of Kern county, and I gladly note down my first impressions. Although occasionally passing through the county during the eight years of my residence in the State, it never came convenient to stop over until now. I am very much surprised at some things, as I think would be many Californians if they could ride over the valley as I have done the past week.

Of course, one expects to find rich land in every county in the great valley of the San Joaquin, but the most remarkable feature of your country is its excellent drainage. Your enormous water system and almost innumerable canals, winding for miles through the country like rivers or creeks, and in every direction, apparently, amply vindicate your claims to the largest irrigation system in the United States. It is well known too that your Kern river, the source of all this water, has the best water shed of any of the many irrigating streams which pour their prolific waters into the San Joaquin valley.

IMPORTANCE OF NATURAL DRAINAGE.

But it is not generally known that your irrigable lands have so remarkable and uniform a slope from

the head of your canals to the western side and drainage outlet of your Kern river valley. This slope varies from four to fourteen feet per mile in the irrigated portions of the valley, being least as we go west, and over the half million acres under your irrigation system the character of the land is such as to permit perfect sub-soil drainage to very much the greater portion of this vast area.

The inestimable value of drainage in any irrigable region is now appreciated in California, especially in places where the people have heretofore ignored the question.

The heavy, water-logged, unproductive condition of the soil in some regions, and the upward movement of the heretofore unknown alkali in other regions, painfully remind irrigators of their failings. If they use more water than enough to supply vegetation with needed moisture, the surplus must be removed or it will greatly injure the productive capacity of the soil.

I do not know any other large area in the State which is irrigated by open canals and yet so well drained as your Kern valley. To arrive at this conclusion it is not necessary to examine the engineers' plats of these irrigation systems as I have done.

"HALF A MILLION ACRES."

A short ride alongside one of your twenty-seven main canals, or any of the hundreds of laterals, will convince the most skeptical of the literal truth of those statements. The solidly constructed restraining "drops" over which the water falls from one to four feet are seen in every direction, and if you ride across the country, the sheen of the falling waters as you ford or cross a canal or ditch every few minutes is exhilarating in the extreme. Every cascade is a forcible reminder of the enormous waste of water power all along your irrigating systems.

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But this word of comment inevitably expands into many paragraphs, and yet we have only touched upon the fruitful and entrancing theme of the reclamation of a wilderness.

Who realizes the meaning of the expression "a half million acres?" The size of agricultural counties east of the Rocky mountains is usually twenty-four miles square, which gives an area of 368,640 acres, so your 500,000 acres of irrigated land is equivalent in area to one and one-half, a good eastern county, while its productive capacity is certainly four fold that of the eastern land, acre for acre.

Taking a lengthened view of the subject, your irrigated area is equivalent to 800 sections or square miles. If those sections were placed end to end it gives us a strip of about the richest land in the world, one mile wide and 800 miles long; equal to the entire Pacific coast line of the State of California, or on the Atlantic coast from the city of New York to Savannah, Ga., or from New York to Chicago. Incidentally it may be mentioned that the justly famous Riverside valley contains 12,000 acres.

CLINTON C. HUTCHINSON.

April 5, 1894.

WHERE A DRY YEAR BRINGS PROSPERITY.

It looks like a dry year in many parts of the United States. Wherever this condition prevails the evils of a drouth will be added to the hardships of prevailing low prices. This is the general rule, but there will be a few notable exceptions. In California the drouth is already a certainty as the winter rainfall fell much below the average and the spring showers were almost entirely missing. This condition of things serves to direct attention to a new aspect of the farming industry among the settlers in the Kern delta colonies.

Of course, readers of THE IRRIGATION AGE are aware that this property is covered by one of the most comprehensive canal systems on earth. It includes 27 large canals and hundreds of laterals

FOR SALE. — First-class medium-sized hotel property in a rapidly growing town. House furnished and doing a nice business now; growing better all the time. Price for property, \$16,000; \$5,000 cash, balance on long time, reasonable interest. None but first-class responsible parties need apply. For full information address Fred R. Reed & Co., North Yakima, Wash.



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164 West Van Buren Street, B 49, Chicago, Ill.

which would themselves be considered large canals anywhere else. If these ditches and laterals were extended in a straight line they would stretch out for more than 1,100 miles. There can be no crop failure, of course, in a locality thus perfectly watered, but immunity from the consequences of the drouth does not measure the advantages which the people of this locality will enjoy this year as a result of the light rainfall throughout the coast.

An enormous area in California is usually sowed to grain, principally to barley, under a system of dry farming. These areas are the principal source of supply for hay. In ordinary years dry farming of this kind is fairly profitable, since no other crops could be raised there without irrigation. But this year such crops are practically a total failure. This means that the usual supply of hay in large portions of California will be entirely cut off. The demand will exist as usual. High prices are sure to prevail. Indeed, they have already set in and the few fortunate localities which can supply the demand will realize splendid profits as the direct result of the drouth. No other district will begin to get as much benefit from this state of things as the irrigated lands of Kern county. There water is cheap and abundant and the price of land so low, and terms of payment so reasonable, that it is within the power of any industrious

W. W. MONTAGUE & CO.

MANUFACTURERS OF ALL SIZES



FOR

Irrigating, Mining, Power Plants,
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SINGLE AND DOUBLE RIVETED.

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12 to 28 Feet.

The Cut on the left shows a Section of Five joints of pipe.

DOUBLE RIVETED IN LATERAL SEAMS.

Particular attention given to Coating Pipe with our "EUREKA" Composition, a Special Mixture Containing **No Coal Tar**. Iron Coated with this Composition is Rust-Proof and Rendered Impervious to the Alkalies of the Earth, is Practically Indestructible.

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man to obtain a small farm. Alfalfa grows prodigiously. Furthermore, railroad transportation is close at hand and the distance to be covered not great. The result will be that from their alfalfa fields alone the farmers of Kern county will enjoy signal prosperity in this year of almost universal depression.

It would be a pity to allow this opportunity to pass without directing attention to this phase of the industry in Kern county. In years when there is no drouth anywhere the system of farming pursued there brings large returns, but in years when other communities are stricken the people of this locality enjoy large prosperity from the growing of the simplest crops.

Kern county shares with the rest of California the glorious climate which has made the State famous. Lands range in price from \$60 to \$75 per acre. As already said, the terms of payment are moderate. Settlers have been going into the country very rapidly this spring, and the tide is sure to continue during the summer, and will swell to a tremendous volume next winter. This means, of course, growing land values. This is the time to buy a home in that country. For further particulars address S. W. Fergusson, agent, Bakersfield, California.

E. L. Lomax, the general passenger agent of the Union Pacific railway, has prepared a book describing the progress of irrigation along their lines. The book is most carefully compiled, and gives the latest and most valuable information obtainable. Mr. Lomax is a wide-awake, active friend of irrigation.

Dandruff is an exudation from the pores of the scalp that spreads and dries, forming scurf and causing the hair to fall out. Hall's Hair Renewer cures it.

A new method of mining, milling, roasting and smelting different kinds of ores has been successfully demonstrated in Germany and is now being introduced with unprecedented success. The slow and cumbersome methods heretofore employed will be discarded, and the cost of various ores in treatment or conversion into metal, especially Lead, Zinc and Silver Ores, Nickel, Cobalt and Copper, greatly reduced. All the matte of the latter, which was heretofore sent to Germany, is now being refined in the United States. THE HARTSFELD GERMAN MINING SYNDICATE, of NEWPORT, KY., invites correspondence. (See their advertisement)

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Arm



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Ten Years.

FREE TRIAL in your own home for 30 days without paying one cent in advance; machine to be returned at our expense if unsatisfactory. We take all risks, pay freight, ship anywhere, to anyone, in any quantity at wholesale prices. \$65 Kenwood machine, \$24.50; \$55 Arlington, \$20.50; \$45 Arlington, \$17.50; \$35 High Arm Gem, \$12. We sell all makes and styles, from cheapest \$7.35 to best "Kenwood," \$24.50. All attachments free. TAKE HIGHEST WORLD'S FAIR MEDALS AWARDED. Over 100,000 now in use. Buy direct from factory. Save agents large profits. Catalogue and testimonials free. Write at once. Address (in full) **CASH BUYERS' UNION, 158-164 W. VanBuren St., Dept. A31, Chicago, Ill.**

"For Years,"

Says **LARRIE E. STOCKWELL**, of Chesterfield, N. H., "I was afflicted with an extremely severe pain in the lower part of the chest. The feeling was as if a ton



weight was laid on a spot the size of my hand. During the attacks, the perspiration would stand in drops on my face, and it was agony for me to make sufficient effort even to whisper. They came suddenly, at any hour of the day or night, lasting from

thirty minutes to half a day, leaving as suddenly; but, for several days after, I was quite prostrated and sore. Sometimes the attacks were almost daily, then less frequent. After about four years of this suffering, I was taken down with bilious typhoid fever, and when I began to recover, I had the worst attack of my old trouble I ever experienced. At the first of the fever, my mother gave me **Ayer's Pills**, my doctor recommending them as being better than anything he could prepare. I continued taking these Pills, and so great was the benefit derived that during nearly thirty years I have had but one attack of my former trouble, which yielded readily to the same remedy."

AYER'S PILLS

Prepared by Dr. J. C. Ayer & Co., Lowell, Mass.

Every Dose Effective

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In order to more successfully introduce into general use the Carpenter Register we have decided to offer for the next ninety days Special inducements to agents who will agree to canvass their district and exhibit in practical operation our Patent Register.

(See our display on another page.)

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THE UNION WATER REGISTER COMPANY,
Rooms 50 and 51 Bank Block,
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For Individual or Colony.

This is a BARGAIN.

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SURE, SAFE AND OF GROWING VALUE.

A GREAT OPPORTUNITY IN A GREAT COUNTRY.

I HAVE for sale a valuable tract of land comprising 640 acres, four-fifths of which is in cultivation, mostly in alfalfa. A paid-up perpetual water right of twelve and eight-tenths cubic feet of water per second goes with the land, all of which is under irrigation. The water is from a ditch whose priority makes it one of the most reliable water privileges on the Arkansas River, and is second to none in everything which goes to make up a valuable water right,

This land has one mile of river front, making it unsurpassed as a winter feeding ground for stock, and is convenient to as good summer range as can be found anywhere. It is two miles from Las Animas, the county seat of Bent County, Colorado, on the Santa Fé Railroad, and *would be valuable property to colonize, cutting up into 10 or 20 acre tracts, for fruit farms.* I prefer to sell it in a body, but failing in this, will divide it to suit purchaser. No trades will be considered.

This land is to-day paying a good interest on double the valuation at which I am enabled to offer it and is a bonanza to any one in a position to handle it. Title perfect.

TERMS: Part cash, balance on long time and low interest.

For full particulars, address,

R. PHILLIPS,

First National Bank, La Junta, Colorado.

PUBLISHERS' ANNOUNCEMENTS.

Does it Pay to Advertise?

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As a rule, it does; it is easy to see that the men who advertise extensively almost invariably succeed in building up a large business. But the question is

Does it pay in The Irrigation Age?

The advertisers who use these columns testify quite unanimously in the affirmative. Consider for a moment why it *must* pay to advertise in THE IRRIGATION AGE.

1. It is the distinctive journal in half a continent, and in that half which must necessarily enjoy the largest and fastest development from this time on.
2. It represents the only large field where the agricultural industry can expand in the United States, and it is good business sense to make a line of goods thoroughly well-known there, with a view both to immediate and future results.
3. The farmers of the arid region are more uniformly prosperous than those who are afflicted by crop failures, and they are therefore more profitable customers as a class.
4. They use more and better goods of all kinds for the same reasons.
5. They are the most intelligent farmers in the world—brains are required to get the best results from irrigation—and they are naturally the first to recognize a good thing.
6. They are confronted on all sides by new problems—How to use water to the best advantage—How to cultivate each acre to get the best results—How to develop the most attractive communities. These problems make them eager to consider and to buy whatever will help them to get ahead.
7. THE IRRIGATION AGE is the *only publication* that reaches this *peculiar field* in a broad way. It is the friend and champion of Western America and has a powerful influence with its field. Every business man who has anything to get before the large, enterprising and multiplying public in Western America should advertise in this journal.

Send for rate card and advertisers' testimonials.

THE IRRIGATION AGE COMPANY,

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HOME BUILDING IN THE PECOS VALLEY.

THE STORY OF A MODERN IRRIGATION ENTERPRISE IN NEW MEXICO.

IF it were announced to-morrow that a new continent had been discovered in some remote quarter of the globe, and that upon that continent was a valley which for peculiar reasons offered extraordinary opportunities for the achievement of industrial independence, and that into that valley capital had gone, and with splendid daring laid the foundation of a modern civilization—if such an announcement were to-morrow flashed over the land and under the sea, the very next day the world would be ablaze with excitement and enthusiasm. The appeal to popular imagination would be irresistible. The appeal to the human instincts of avarice, of adventure and of conquest, and, above all, to the intense human longing

in the valley of the Rio Pecos as in the story of any of the colonial settlements made upon American soil in the past. We cannot see to-day that the historical significance of the modern instance is at all to be compared to those of former times, but like our predecessors we may be building better than we know. Those who founded the first English colonies in America regarded themselves as merely fellers of trees and builders of homes. They were more interested at the moment in finding bread and butter than in founding institutions. And when we contemplate the enormous possibilities, political, social and industrial of Western America, it is easy to imagine that what is being done to-day in the Pecos Valley will



EDDY DISTRIBUTING RESERVOIR, PECOS VALLEY SYSTEM.

to find better conditions of living, would instantly start armies of home-seekers toward the newly discovered land of opportunity.

SOMETHING NEW ON AMERICAN SOIL.

And yet these conditions should have precisely the same interest for the public if found somewhere under the American flag that they would possess if found in a new and mysterious domain. The Pecos Valley of New Mexico is just as truly a field for human conquest as were the shores of Plymouth bay when the pilgrims landed there. In both instances there were difficulties to be overcome, problems to be solved and institutions to be created. There is as much dramatic interest in things transpiring to-day

be seen in the future to have meant very much indeed to the country and the race. But let us look for a moment at what has already been done.

AN EXAMPLE OF DARING ENTERPRISE.

Six years ago the Pecos Valley belonged all but absolutely to barbarism. It was a long and dreary waste of perfectly desert soil. In places water had been taken out of convenient springs to coax a little verdure around a few cattle ranches, but in the true sense the first blow had not been struck for civilization in this valley. Chas. W. Greene drifted in from the north, bent upon newspaper work in connection with the Santa Fé *New Mexican* and the collection of material for a new book of brands.

His attention being directed to a modest scheme of reclamation at the head of the valley, he proceeded to study the conditions presented and immediately his capacious mind grasped the possibilities of a grand undertaking. He made the acquaintance of C. B. Eddy further down the valley, and the result was the development of a large plan of reclamation. Later, J. J. Hagerman, one of the famous millionaires of Colorado, was interested, and with him came a stream of capital, backed by unlimited courage and faith.

In this six years there has been constructed one of the largest and most substantial systems of irrigation works on this continent, covering a territory more than 200 miles in length, with 1,200 miles of main and lateral canals. But the land covered was off the line of the railroad, and so these plucky men built a new railroad from one end of the valley to the other, and equipped it with the finest modern locomotives and rolling stock. But even a railroad does not answer all the demands of commerce for rapid communication, and so these men built telegraph and telephone lines, and brought a locality formerly almost as remote as Central Africa into the closest touch with the world. Not satisfied with even canals, railroads, telegraphs and telephones, they made cities and towns of the best modern type, erecting fine hotels, business blocks, public buildings and beautiful residences. This, in brief, is what has been done in six years by American brains, pluck and capital in the transformation of a desert. Should it not appeal to-day with greater force to American men and women than if it had been done upon some new continent in a remote portion of the globe?

I.—THE PECOS VALLEY AS IT WAS AND AS IT IS.

The accompanying map shows the general location of the Pecos country. It is in the extreme south-eastern quarter of New Mexico, bordering upon Texas, and within a few hours' ride of Old Mexico.

The valley has an average width of ten miles, and its surface is remarkably even, although in places there are high bluffs and gently sloping mesas, with shallow canyons along the river. Until the present development began, the country was utilized for range purposes, and is, therefore, full of the romance of the frontier. The valley is flanked on the west by the Guadalupe and Sacramento mountain ranges, but on the east slopes away to the Staked Plains of Texas. The fact that it is so abundantly watered made it a favored cattle range in the past. The soil is largely of limestone formation and closely resembles that of the richest and most populous valleys in Central New York, Pennsylvania and Virginia. The natural growth is the mesquite tree and the dry grasses of the arid southwestern plains.

THE RIO PECOS.

The valley is watered by numerous rivers and springs, but the chief source of supply is the Rio Pecos, which is one of the more remarkable rivers of the arid region. It rises high up in the Rocky mountains, gathering its supplies from snowy peaks, draining a tremendous area and emerging from the lower ranges into the plains a river of very respectable size. Its channel is deeply eroded and its volume constantly reinforced by surface springs and underflow waters. The Pecos carries more or less mineral qualities, but is well adapted for irrigation.



NEW MEXICO, PECOS VALLEY IN EXTREME SOUTH-EASTERN PORTION.

THE WATER SYSTEM—IMPOUNDING THE HONDO.

The great canal system of the Pecos Irrigation and Improvement Company begins at the northern end of the valley, in the neighborhood of Roswell. Here the Pecos receives one of its largest tributaries, the Rio Hondo. This stream is born of the snows of the Sierra Blanca range, and near its mouth is reinforced by a series of wonderful springs. Five of these springs furnish supplies ranging from 400 to 825 gallons per second, respectively. Here a large reservoir has been constructed from which is taken the Northern Canal, which is thirty-five miles long at present and capable of extension. It carries a stream thirty feet wide and six feet deep, watering 67,000 acres of land.

HOME BUILDING IN THE PECOS VALLEY.

TWO GREAT RESERVOIRS.

For the irrigation of the central and lower portions of the valley water is impounded in two large reservoirs, one of which has a capacity of six billion cubic feet. This is known as the Seven Rivers Reservoir, and the beautiful lake which it forms has been christened Lake McMillan, after one of the officers of the company. The presence of such a body of water in the midst of what was formerly a barren waste is a very notable thing in itself, and must surely lead to the development of a most attractive summer resort. Already row boats and sailing craft are seen on its surface. This and the Eddy Distributing Reservoir, twelve miles further down the valley, are magnificent creations of engineering skill. Their characteristic features are simplicity and strength. They are sub-

those who are studying the valley for the more important purpose of home-making only desire to know that the water supply is abundant, that the works are substantial, that the water is suited to irrigation, and that the company behind the enterprise is strong enough to meet all demands upon it, either for such repairs as may become necessary, or of such extension as increasing settlement shall demand. These are the settlers' questions, and they can all be answered emphatically and affirmatively. The water supply is all right, and the system ranks among the finest in the world.

THE PRODUCTS OF THE VALLEY.

Except in the neighborhood of Roswell, the agricultural and horticultural development of the valley dates no further back than five or six years, and with



VIEW OF MAIN CANAL, PECOS VALLEY IRRIGATION SYSTEM.

stantially alike in method of construction, being over 300 feet wide at the base, fifty feet high and eighty feet wide at the crown. The Eddy dam is 1,150 feet long and that at Seven Rivers 1,686 feet. In both cases most ample provision of spillway capacity has been made, and it seems impossible that any flood or cloudburst can disturb the structures. The Southern Canal, leading from the Eddy Reservoir, is now forty miles in length, carrying a stream forty-five wide and seven feet deep, which crosses the river through a substantial flume 468 feet in length. The East Side Canal, fifteen feet in width, is also supplied from this source.

THE WATER SUPPLY IS ALL RIGHT.

If this article were written for engineers, the great Pecos system would require extended description, but

the exception of one farm on the Lower Pecos, it goes only two or three years into the past. At Roswell we see what water, soil and sunshine have done in a dozen years, although not under the best conditions and methods. The exhibit of the Pecos Valley products in the company's office at Eddy furnishes the most convincing proof of the value of the climate and soil. It covers a very wide range, including almost every product of the temperate and semi-tropic zones except oranges and lemons. All the deciduous fruits, all the garden vegetables, all small fruits, all the cereals are represented in the collection by the finest specimens. As each specimen is accompanied by a card stating the name and address of the party who raised it and the date of the harvest, there can be no doubt that the specimens are genuine

ADVERTISING SUPPLEMENT.

products of this valley. Nothing except the most critical examination would satisfy individuals who desire to learn the facts about the products of the country, but the writer can say for himself that he saw nothing superior to it in all the displays at the World's Fair.

IN THE ROSWELL COUNTRY.

The Roswell country is at this time the most interesting portion of the valley. It is green and beautiful with vegetation and fragrant with the breath of alfalfa blossoms. Its apple and peach orchards have, in many instances, come to maturity, and are heavily laden with fruit. Its homes and door yards have the beauty which comes with age. The altitude is higher by 500 feet than at Eddy, but in all other respects the valley is similar throughout its length.

AT THE HAGERMAN FARM.

Another convincing demonstration of the character of the country is seen at the beautiful Hagerman farm, southeast of Eddy, which is also the product of one of the earlier ditches. Here there is a fine orchard of peaches, apricots and plums, as well as gardens, alfalfa fields, lawns and long rows of stately cottonwoods. All vegetation is in a state of the highest thrift, so that at this end of the valley, as at the other, we see a living argument of the good character of the soil, climate and water.

MR. GREENE'S PROPERTIES.

The properties of the Greene's Vineyard Company and the Pecos Irrigated Farms Company, as well as Mr. C. W. Greene's personal estates, must be noted as among the most ambitious and attractive agricultural and horticultural creations in all Arid America. There is a vineyard of 600 acres which will ship several trainloads of the best table grapes, of assorted varieties, to the eastern market during August and September. The lands of the Farms Company are prosperous with alfalfa, Egyptian corn and sorghum. One of Mr. Greene's additions near Eddy is laid out as a park, planted to fruit and shade trees and flowering shrubs, and designed to furnish the finest villa sites in the West.

EVERYTHING BUT HUMAN INDUSTRY.

These are the barest outlines of the Pecos Valley as it was and as it is. The foundations of a civilization have been laid. The canal system is the great skeleton and the Pecos Valley railroad the great artery of commerce. But the flesh and blood will be supplied by the development of thousands of small farms, and the outward beauties will come with age and prosperity. Think of the barren wastes of five years ago, and what has already been done seems like a mighty achievement. And so it is, but the

greatest things remain to be done. The material of a wonderful life for this valley is all here except the greatest element of all, and that is human industry. Let us now study the subject from the standpoint of the home-builder.

II.—THE HOME-BUILDER IN THE PECOS VALLEY.

Everything has been done to make the Pecos Valley ready for the settler. The soil is waiting for the electric touch of man's labor. And what the reader wants to know is the capabilities of this soil for the production of prosperity for average people. The very poor live in the tenement districts of great cities. The very rich live where they please. The strength of a nation is in its average people, and these average people desire to live where they can be in the best sense independent, and where the distribution of life's necessities and comforts is reasonably even. It is from this standpoint that the writer has studied the Pecos Valley, and every statement in this article is made with the conviction that it is true and will stand the test of investigation and experience.

A NEW COUNTRY MEANS NEW PROBLEMS.

First, then, let it be said that the Pecos Valley is a new country. Its rough edges are apparent to the most casual observer. Settlement in a new country involves some sacrifices. To make a success of it requires a reasonable amount of time, money, patience and industry. This is particularly true in an arid country, where the soil is for the first time made acquainted with crops. A new country is full of new problems. These cannot be solved in a day. These statements apply with equal force to all new countries, but in each locality the difficulties are different.

EARLY DIFFICULTIES.

Your Puritan ancestor cut down trees and pulled up stumps. In the Pecos Valley the land must be cleared of mesquite, then leveled and ditched. This



IN THE HAGERMAN ORCHARD.

THE IRRIGATION AGE.

VOL. VI.

CHICAGO, JUNE, 1894.

No. 6.

THE PROGRESS OF WESTERN AMERICA.

*Overheard
in Wall
Street.*

It has frequently been asserted in these pages that the outlook for irrigation and colony development in the Greater West is better to-day, in the midst of uncertain times and widespread depression, than it has ever been before. The statement has been made in good faith, and is founded upon a knowledge of certain currents that are, perhaps, better known to the writer than to the public generally. Important business plans that may be definitely discussed in private circles long before it would be prudent to make them public often furnish good ground for confident predictions about the future. During the first days in May an interesting conference occurred in New York City, at which the future of irrigation and general western development was discussed by several gentlemen representing very different points of view and experience. One of the party had just arrived from Europe, where he has placed, personally and through agents, not far from \$3,000,000 of irrigation securities in the past three years. Another who was present is one of the most eminent of New York lawyers, who is in very close touch, from his office in Wall street, with the most conservative class of eastern financiers. A third gentleman is the owner of about two million acres of land in the arid region, and he enjoys a very extensive acquaintance with financial men and institutions on both sides of the Atlantic. The fourth party is a foreigner, but one whose business has kept him in this country, engaged in the most exhaustive study of irrigation enterprises, for months past. The fifth party at the meeting was the editor of THE IRRIGATION AGE. These five persons perhaps represented as fairly as any five who could have been assembled the various elements of knowledge and observation essential to a just analysis of the situation, at home and abroad, and to a reasonable forecast of the future. Europe, New York and the West were reflected in the views expressed, and the temperamental differences represented in the several personalities were as wide apart as the localities from whence they came.



PROF. CHARLES D. WALCOTT,

Of New York, nominated by the President for Director of Geological Survey, *vice* Powell Resigned. See page 233.

*Here are
Opinions
Worth
Having.*

The European financier stated that during the past few weeks interest in general investments had notably awakened; confidence is being gradually restored throughout Great Britain; the total amount of money hoarded up as the result of the panic following the failures in Australia and the United States, and the collapse of English trust companies somewhat in consequence of foreign disasters, is enormous, in spite of the vast losses; this money is beginning to ask how it can earn a fair rate of interest without unreasonably hazarding its principal; faith in America as the field of future industrial expansion, and in Western America as the part of the United States where the growth of values will be largest and most rapid, is deeply founded. To these generalizations the European emphatically added the

statement that the best business heads in England pronounced irrigation bonds to be certainly the favorite security of the future, but he said, with even stronger emphasis: "Your projects will be investigated hereafter from top to bottom by men thoroughly known to us. We will take nothing more on faith. Convince us that you have a safe thing and our money will be forthcoming." The New York lawyer heartily concurred in these opinions, speaking from his own observations. He said irrigation securities were beginning to be favorably known, and that the physical elements back of them—lands enormously productive when watered, and the water supply and canal system, on which their productiveness absolutely depends—were recognized as the best foundation for security, when associated with good plans for colonization. All that these gentlemen had said was confirmed by the second foreigner, who had spent several months in a thorough examination of certain irrigation plants, and declared that the investigation had settled the merits of the industry beyond all question in his mind. The party was unanimously of the opinion that the present is a favorable time to formulate plans for extensive development, and that if no unforeseen disaster overtakes the industry, capital and settlers will be found in abundance, and we shall enter upon a long period of prosperity in the business of reclamation and colonization.

Danger Points to be Guarded. Speaking, then, from a good knowledge of the situation throughout the United States, as studied in recent personal visits to both sides of the continent, and from the best of hearsay evidence about conditions abroad, we say without the slightest hesitation that the outlook for Western America in general, and irrigation in particular, is most flattering. But there are certain grave dangers to be guarded against. It is within the power of unscrupulous or incompetent men to very seriously impair the confidence of both the investor and the settler. A few reckless projects successfully unloaded upon the market, and a few settlers deluded into making their homes on poor land, or under a doubtful water supply, and confidence in irrigation and all that pertains to it will be stricken down. But if it is within the power of a few men to work disaster, it is still more clearly within the power of a few men of a different type to prevent it. For it is much easier to discredit an enterprise than to float it—much easier to keep settlers out of a locality than to coax them in. There is not the slightest need of repeating in the case of irrigation the hard lessons that have been taught, at different periods, by town-lot booms, wildcat mining speculations and thrice-counted cattle deals. No one can foretell the destiny of a new town, or fathom the mysteries of a mine, but irrigation rests on things

that can be seen and measured, and results are worked out by means of plain, ordinary human industry. There are plenty of good enterprises and therefore not the slightest excuse for anybody to engage in doubtful ones. And yet there have been some unfortunate results in connection with irrigation investment and with settlement upon irrigated lands. It is well to speak plainly of the methods by which such misfortunes may be hereafter prevented.

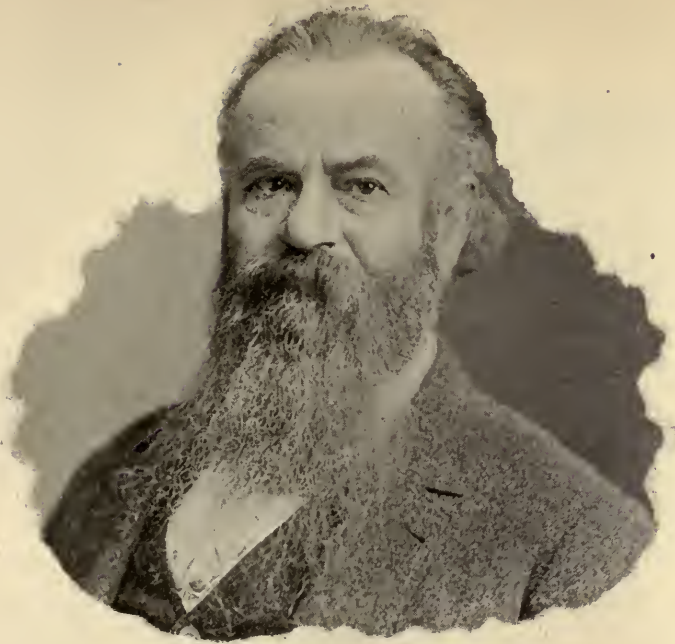
The Bear Valley Instance.

The most important failure in the irrigation world—the only failure that has attracted international attention—was that of the Bear Valley Irrigation Company of California. That enterprise was regarded as the type of irrigation investment. And, strange to say, it is destined to be so regarded again. It is a property of extraordinary and undisputed values, but its managers capitalized the future and clipped coupons from their imagination. Industrial development gave place to stock manipulation. There may not have been a particle of studied dishonesty in the whole transaction, and yet with proper vigilance on the part of those who should protect the public from imposition Bear Valley stock could not have been sold on the basis of a fifteen per cent. dividend-paying investment. Here was an enterprise whose merits warranted the liberal investment of capital, whose values were and still are so large and substantial as readily to command between one and two millions of eastern and foreign money, and yet it is perfectly plain, in the light of the present receivership, that investment was invited and obtained on terms that were hazardous. The irrigation industry was not at fault, but the irrigation industry has suffered the consequences of the failure. The world learns by experience. There should never be another failure due to the same causes as those that produced the temporary defeat, with accompanying losses, of Bear Valley. Enterprises that are floated on the still hunt plan, and about which investors made no inquiry from disinterested sources, may still breed disappointment and distrust, but it should be easily possible to prevent wholesale deception in the case of projects placed publicly on the market, or in the case of those where intending investors make a proper effort to learn the truth.

Defrauding the Home-Seeker.

What has been said of investment in securities may be said with still greater force with reference to investment in small tracts of irrigated land. The man who takes all the money he possesses and invests in a little farm on which he must make his living is properly a greater object of solicitude than the man who invests his surplus capital in bonds. To cheat the home-seeker is an unpardonable enormity. This has been done only to a very slight extent, but there is one grievous instance in California, now in process of

Several years of observation have convinced us that there is a great public service to be done by the frank discussion of every land and water enterprise in which people are asked to put their money, either for the purpose of investment or of home-making. For this service the public has a right to look first of all to THE IRRIGATION AGE, which, perhaps more than any other factor, has educated this same public to a comprehension of irrigation in its various aspects. We boldly assert that no irrigation proposition which this journal shall attack upon just grounds can be successfully imposed upon the market. This assertion is by no means extravagant. Confidence of the investing public is a plant of slow growth. It is a delicate thing even at its best. A journal which has earned its place as a standard authority in its peculiar field, and which circulates in every civilized country



MAJOR J. W. POWELL.

Late Director of U. S. Geological Survey.

adjustment, that may yet call for the most complete exposure. It is the case of an irrigation district where schemers and manipulators have imperiled the fortunes of a community of honest, hard-working men. It is high time that the public realized that no locality has anything to gain by the attraction of money or people under false pretenses. In the end it is the whole community that must bear the loss and humiliation. No newspaper or influential citizen of the West should be so cowardly as to permit deception to be practiced without the loudest and most persistent protest. Irrigation and land enterprises are not private affairs in the ordinary sense. They involve the reputation and prosperity of large districts and, in a degree, of the peculiar industry in half a continent. It is a public duty to assist good ones, and equally a public duty to prevent the evil success of bad ones.

"The Age" Hitherto it has not been the policy of **will Expose Doubtful Enterprises** THE IRRIGATION AGE to meddle with the affairs of individuals or corporations engaged in selling bonds or lands. We have done all we could to set forth and illustrate the abstract strength of irrigation securities and the general advantages of homes on irrigated lands, but we have repeatedly reminded the public that every proposition should be investigated upon its own merits. We propose now to sharply reverse this policy of non-interference.

JOHN G. STEFFEE,
Of Wichita, Kansas.



HEAD WATERS OF THE PECOS RIVER, NEW MEXICO.

By permission of the New Mexico Bureau of Immigration.

among circles especially interested in investments, can prevent the success of any project which does not deserve to succeed. It is not a grateful task to assail anybody's project, but it is a pleasure compared with the sensation of witnessing the needless loss of honest dollars in an industry which offers the most ample security for investment and the most generous return for human industry. *There ought not to be another irrigation failure of any consequence in the next five years.* There will not be if western men do their duty, and eastern and foreign agents and investors exercise proper care. THE IRRIGATION AGE invites the public to call for a statement of any water and land enterprise in which the public is asked to invest. We will state the facts fearlessly, concisely and as promptly as they can be ascertained and verified, and we invite all friends of Western America to join us in a war of extermination against every species of fraud and deception in this, the most magnificent field for investment and industry now open to human enterprise.

The Unemployed and the Public Lands. The people of this country are suffering a good deal of distress just at this time, but the things they suffer now are not as bad as those they dimly fear. They are oppressed by dread of grave consequences to flow from the congested population of great cities, from the idle hands in manufacturing towns, from unprosperous and therefore discontented planters and farmers on southern and mid-western farms. And in their distress, present and prospective, they turn as they did of yore to the great West, where elbow room has always been found for surplus men and energies. Propositions looking to the speedy occupation of the arid public lands are cropping up in all parts of the country. The labor unions of Cincinnati demand that the unemployed shall be set at work constructing canals to reclaim public lands and that they shall then be permitted to make homes upon these lands. Similar propositions have been advanced in Chicago, St. Louis and Denver. An impressive resolution adopted by the St. Paul Chamber of Commerce recites that no good can come of the weary tramp to the national capital; that banks have got down to bedrock; that all industry and commerce are in process of readjustment; and, finally, that it is apparent that cities and towns are overgrown and that the solution of the economic tangle is the location of surplus population on surplus agricultural lands. All this simply confirms what has long been asserted and predicted by the men of the West. It is all very true. The future belongs to Arid America. There alone can population safely expand; there alone can labor win independence; there alone can a new and a better civilization be erected under the impulse of the new century about to be born.

Obstacles to the Movement.

And yet the results so much to be desired cannot be realized immediately. Large objects move slowly. It is not possible under any laws now existing to set at work even one thousand men in the reclamation of the arid lands. The desert land law grants the settler a half section at a cheap price, and upon easy terms of payment, but money is required, nevertheless. Not only that, but engineers, expert direction and large working capital are required. None of these things can be supplied under our present laws. We cannot make a law that will apply to an isolated case. What we need, and what we must obtain within the next year or two, is a comprehensive national irrigation policy, supplemented by good State laws. This cannot be spoken into existence to meet the present emergency. But it can be formulated at the National Irrigation Congress next September and carried triumphantly through Senate and House next winter. How fortunate it is, in view of the present insistent demands of the public, that the last Irrigation Congress created seventeen State and Territorial commissions to study the question of irrigation policies in every aspect and report the views of the people, together with the facts relating to the lands and waters, to another session to be held in the early autumn. We are coming, Father Abraham, and we will bring with us the noblest opportunities for labor and for capital and the grandest promise of independence and equality.

Plenty of Homes are Waiting.

But although some little time must pass before the new national policy can be perfected, no industrious man need wait a moment for a small irrigated farm. Millions of acres are under ditch, but not under cultivation. In a dozen localities farms can be obtained on the easiest terms. In Washington there is a company which sells land and takes its interest and principal in the form of a part of the crop. The settler can have as long a time as he may need to pay for his home, and is not required to pay a dollar that he does not take from the soil, nor a dollar that he cannot spare above necessary living expenses. There are good lands in California, Idaho, Utah, Colorado and many other localities that can be obtained on much the same terms. So that Arid America can furnish a sufficient outlet at this very time to relieve the pressure upon the country. Nevertheless, no time should be lost in making ready for the accommodation of the great and permanent stream of home-makers that is about to set in.

David Lubin and His New Economic Idea.

David Lubin, a merchant of Sacramento, Cal., has recently attracted wide attention throughout the West and South by the publication of a new remedy for the present low prices of wheat, cotton and other staple products. In

his various newspaper articles Mr. Lubin has stated his views with a force and clearness that have attracted instant attention. It is difficult to reproduce his reasoning and conclusions in small space, but briefly they are as follows: The United States pays the highest average wage rate of any country in the world. This fact is due to the protective tariff. But those benefited by protection do not bear the cost of it. Neither does the foreigner pay it. "They alone pay it who live and produce under it and are compelled to sell their products at free trade prices." He proves the latter assertion by saying that the



DAVID LUBIN,
Of Sacramento, California.

price of wheat is fixed by the price which the surplus product commands at Liverpool, in competition with the product of the poorest and cheapest unprotected labor of foreign lands. To remove the protective tariff, he says, would bring disaster to manufacturers and therefore to the country; to continue conditions which impoverish the farmer will also lead to inevitable disaster, not alone to those who till the soil, but to those whose labor is now employed in manufacturing goods consumed by tillers of the soil. He says the remedy cannot be found in silver coinage, even if it be universal. That would increase the price of commodities, and so increase the burdens of producers, but the value of their products would still be established by the price of their surplus at free trade Liverpool, where they would come into contact with wheat and cotton raised by ryots and peons. These, then, are Mr. Lubin's premises and here is his remedy:

That the government of the United States shall pay a sum out of its custom house receipts in order to reduce the price of freight on exports of staple agricultural products. For instance: If the price of freight is 20 cents a bushel on wheat, let the government pay 10 cents and the shipper 10 cents. It will make the price of wheat 90 cents in place of 80 cents.

**General
Objections
Answered.**

Mr. Lubin anticipates and answers several objections to his plan. He declares that it is not a bounty, since the government would make the proposed payment only upon the portion of the crop exported. He thinks it should not be opposed by eastern workingmen, since they will be benefited by the prosperity and consequent ability to buy, of the agricultural classes. He takes issue with those who propose to limit the production of wheat by saying that such a thing is just as impossible as to say how many shoemakers or bricklayers there shall be. Mr. Lubin is pushing his idea with much vigor and at an opportune time. The matter naturally attracts wide attention and as naturally commands the support of the masses of western and southern producers. They are suffering from prices that enable them only to barely exist. They think there has been an unfair distribution of government favors and of general prosperity.

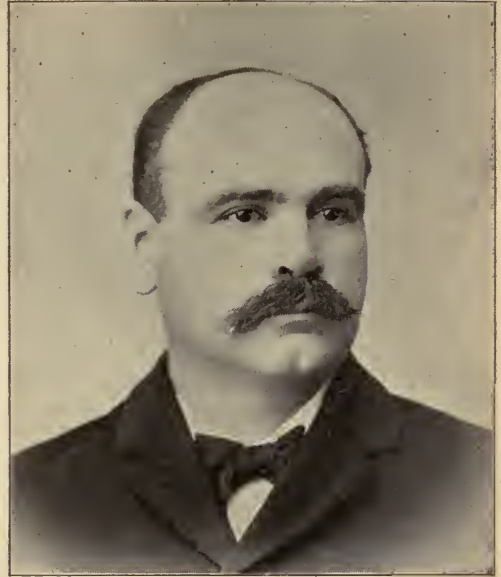
**The One
American
Policy.**

We agree with Mr. Lubin's premises, but do not share his confidence that his proposed remedy will soon become a popular, still less a dominant, political issue. It would raise--unjustly, we think--the fiercest sectional animosities. It would array in opposition all the mighty forces of conservatism. It would make the most dangerous of political alignments--that of class against class. And we have not the slightest idea that it could prevail except on the tide of an irresistible revolution. Speaking now not as a partisan, but as an American of the western school, we say that there are but two pathways of which our people may make choice. One is free trade, as nearly absolute as revenue-producing necessities will permit; the other is protection, consistently applied to every interest of our people. The first means that we shall enter the world's markets on the world's terms. Our wheat-grower must accept the same pay per bushel as the Indian ryot and the Mexican peon, saving only such advantages as he may have in superior muscle, agility or machinery. So also with all other laborers, mechanics and artisans. We must work for the world's markets, accept the world's prices, live as the world lives--the standard being set by the meanest labor in the lowest country on the globe. Either that, or we must protect and foster our home market and be sustaining within ourselves. Then we control our own situation and maintain our present wages, our present scale of living, the present surpassing quality of our civilization. As for wheat, there must be no surplus. Fortunately we are no longer enormously expanding our wheat-growing area. Demand must steadily gain on supply. The day will come when we shall import wheat, and thereby raise its world-wide price. We shall settle millions of acres of new lands, but not with one-crop

farmers. If Mr. Lubin's issue were up for settlement to-day no one would have reason to fear it if the people decreed its trial. Every interest in this country will be benefited by decent prices for wheat and cotton, but the two great policies before referred to are now on trial. And after them will come the money question. Mr. Lubin's idea is interesting and he sustains it by ingenious argument, but as a political issue it is remote.

The Country is All Right. A discussion of these ideas brings us rather closer to politics than it is the habit of this department to approach. Before leaving the subject we desire to say that the present flood of radical speech and literature does not alarm western men. They see in the present unrest the dawn of a better day. Out of the present dissatisfaction of the masses will come purer laws, stronger leaders, nobler institutions. Better the clamor of the flowing stream than the stench of the stagnant pool!

Co-Operative Irrigation on the Plains. John G. Steffee, of Wichita, Kansas, advances in the colony department of this number of *THE AGE* a plan for co-operative irrigation on the Great Plains which seems to be as promising as it surely is unique. It is the most practicable suggestion we have yet seen for distributing prosperity throughout the semi-arid region with something like an even hand. There are many things about the irrigation possibilities of the plains yet unknown, but two important facts are known, as follows: first, the country between the 97th meridian and the Rocky mountains will not ordinarily produce sufficient crops without artificial watering; second, there is not enough water to insure crops upon any large proportion of it, and yet it has nearly all been taken up by settlers, none of whom want to surrender their lands if it be possible to contrive a way to hold them. Mr. Steffee recognizes these facts and proposes a scheme to meet these conditions. Briefly, it is a plan of co-operative irrigation, whereby a quarter-section shall be irrigated in the center of a dry-farming district and cut up into little farms of from one to ten acres for the use of different families. Here they will have their homes, if they desire, and here they will raise vegetables and fruit for their own uses and a surplus for market, perhaps. In the meantime, they will operate their big farms in the old way, getting a crop of wheat or corn when the rainfall permits, as it often does. The irrigated ground will insure them a living. Farmers may unite their capital or labor in developing water and building canals for the land used for the co-operative farming. The plan looks entirely feasible and we hope to see some enterprising locality make a thorough trial of it immediately.



LINCOLN FOWLER,

Author of Article on "Ancient and Modern Arizona" in May Number.

Mr. Fowler's Arizona Article. The article published in these pages in May on "Ancient and Modern Arizona" constituted one of the finest contributions to recent irrigation literature. It covered a very wide range historically, topically and territorially and did it in comparatively small space. It was the work of Lincoln Fowler, the quality of whose writing surely ranks him among the best literary men in the Territory. He is a resident of Phoenix and has enjoyed years of experience there as irrigator and rancher. Mr. Fowler has profound faith in the future of Arizona. He believes its deserts are destined to blossom with the homes of men. He expects to see that country soon begin to attract the earnest attention of homeseekers, as it already has that of large capitalists.

Idaho's Commission at Work. Chairman Babbitt of the Idaho Irrigation Commission reports that the people of his State are deeply interested in the work of that body. The trenchant discussion of Idaho water and land problems, delivered by F. J. Mills of Pocatello before the commission at its Boise meeting in March, has now been published in pamphlet form. It is of more than local interest, since much of the address applies with equal force to many other parts of the arid region. Mr. Mills declares it to be the paramount duty of Idaho's people to make preparations to receive their share of the surplus population of the older sections. He says the Snake River val-

ley will provide forty-acre farms for 20,000 proprietors, who, with an average of five to the family, would make a population of 100,000 people on the farms. This would require, including the natural growth of towns and industries, a total population in the valley of 250,000 souls, Mr. Mills estimates. He believes the best of all plans would be to have the general government undertake the work of reclamation. Failing in that, he would advocate cession to the States as the next best plan. He advises stringent State laws regulating appropriations and ditch management. Mr. Mills should favor every member of the State and Territorial commissions with copies of his address.

**Southwest
Nebraska
Aroused.** A very interesting irrigation convention was held at McCook, Nebraska, early in May. It resulted in the organization of the Southwestern Nebraska Irrigation Association, which will take up the work of introducing the best methods of obtaining and applying water. This territory is a fine country and will be speedily transformed from a semi-starvation belt to a land of plenty by irrigation. It is quite abundantly supplied with water, has a fine climate, a rich soil, good transportation facilities and is conveniently near to large markets. Most interesting developments may be expected there during the next two years.

**Major
Powell
Retires.** The resignation of Major John W. Powell from the high office of Director of the Geological Survey was tendered to President Cleveland, May 10th. The reason assigned is ill health, and those near to Major Powell know only too well the entire genuineness of the excuse. He was severely wounded in the war, and during the past few months he has suffered great pain from complications due primarily to his wounds. It has become absolutely necessary for him to put all work aside, seek perfect rest, recruit his health, and then, if able, submit to a severe operation. Six months ago Major Powell informed the writer, in confidence, that his resignation would be tendered before the middle of the present year, and that the rest of his life would be devoted to gathering the results of his work into presentable literary form. It is sincerely to be hoped that he will have the strength and length of days to perform the high literary tasks he has set for himself. If so, a valuable and interesting portion of his career is still before him.

**His Work
in the
Far West.** Major Powell is a many-sided man. He has won distinction in several departments of science, in literature, in war, and in the field of exploration. The Geological Survey was his creation. There is not space here, nor is this the fitting time, to review his life and work as a whole, to pass upon what he has tried to do and what he has accomplished, to speak of his strength and his

weakness, his successes and his failures. But it is highly appropriate that his retirement from public life should be accompanied by a statement in these pages of Major Powell's services to Western America. This statement is made elsewhere, by another pen. Whatever praise may be accorded or denied him, no honest mind will dissent when it is said that John W. Powell has done more than any other single individual to banish from the popular mind the picture of Arid America as a dreary, barren and utterly worthless waste and to erect in its place a vision of Arid America as a land whose scenic beauties outshine all the storied scenes of Europe, and whose industrial possibilities promise a future civilization greater than any of the past. Remembering this supreme service to our new West the severest critic of his later utterances will join *THE IRRIGATION AGE* in the hope that Major Powell will enjoy a speedy return to good health and that his life may long be spared.

**John
Hyde's
Good
Work.** Hon. John Hyde, of Nebraska, expert special agent of census in charge of agriculture, appointed January, 1890, has just completed his work. His appointment was entirely non-partisan, his peculiar fitness for the position being urged upon the appointing powers by a very large number of leading agriculturists, journalists and railroad officers of the country, without distinction of party. While he had investigated the agricultural and other industrial conditions of the country to the extent of visiting for that express purpose every state and territory, not excepting even Alaska, his long residence in the West, and the prominence he had attained in the exploitation of its various resources, rendered him an eminently fit representative of that great region in the decennial stock-taking of the nation. It was Mr. Hyde's declared intention that the agricultural work of the 11th census should constitute a more complete and accurate setting-forth of the condition of the great interests with which he was intrusted than had ever before been attempted, and the success of his endeavors is attested by the wide range of his preliminary reports and by the fact that even results for which the country was totally unprepared have been accepted without reserve on the strength of the manifest thoroughness of his methods. That the census office has for the first time taken cognizance of irrigation is due entirely to Mr. Hyde's earnest and persistent advocacy of its claims to recognition, and it is an open secret that Mr. F. H. Newell would not have been permitted to complete his laborious investigation of that subject on the scale on which it was undertaken had not a strong western man been at the head of the entire agricultural work of the census. Mr. Hyde is a member of the Council of the National Geographic Society and a Fellow of the Royal



HON. JOHN HYDE,

Of Nebraska, Expert Special Agent, Agricultural Division, 1890 Census.

Statistical Society of London, the American Statistical Association, and other literary and scientific societies at home and abroad. The editor of *THE IRRIGATION AGE* was among those who predicted for him a brilliant success in the office he has just vacated, and it is accordingly with more than ordinary satisfaction that he now offers his congratulations.

Mr. Hyde In *THE AGE* for February we referred to the need of trained men in the service of the various States and the larger irrigation enterprises. The retirement of Mr. Hyde from the census department reminds us again of the subject, for this gentleman is an admirable type of the kind of men referred to. He is a man of the

broadest intelligence, skilled in practical economics, well-seasoned in the public service, and yet in the youthful prime of life. Apply a man of these equipments to the irrigation and colonization problems of any of our western States, from Nebraska to California, or to similar departments in any important private enterprise, and results must be obtained with mathematical certainty. We do not know what plans Mr. Hyde is making for the future, but we should rejoice to see his great energy, trained abilities and exceptionally valuable experience utilized by some of our States, or at least by some of our extensive irrigation enterprises.

Director Walcott. The new Director of the Geological Survey, Prof. Charles D. Walcott, is a man in the prime of life, thoroughly trained in scientific work, possessed of good executive ability and enjoying the confidence and respect of the staff of brilliant young men by whom he is surrounded. He was born forty-four (44) years ago at Utica, New York. In person he is six feet tall, slender, agile in movements, and decided in manner, while his blue eyes and sandy hair and beard reveal the influence of his Scotch-Irish ancestors. When only thirteen years old he became interested in geology, picking up chance specimens and making a little collection of his own. He shortly became acquainted with an old explorer of the country who sold

specimens at Trenton Falls, and after this he pursued his diversion more systematically. The following winter he was thrown into association with Col. E. Jewett, a well known geologist and conchologist, who loaned him books and somewhat directed his tendencies. Leaving the public academy after a short course he was a clerk in a hardware store for two years, then becoming a dairy farmer, which vocation left him many hours every day for study and geological investigation, the region furnishing a great variety of geological phenomena. The first paper published by Mr. Walcott was upon the relation of geology to agriculture, read before the Farmers' Club of Oneida county, in 1873. Shortly afterward he was



E. L. LOMAX,

General Passenger and Ticket Agent, Union Pacific Railway.

placed on the geological survey of New York State, and in July, 1879, was appointed on the staff of Mr. Clarence King, then Director of the United States Geological Survey, serving as assistant geologist on work in the Grand Canyon district in Utah and the Eureka mining district in Nevada, subsequently being placed in charge of the paleontological division, to which was soon added the division of geology. He is one of the most genial and conciliatory of men, and while not at all inclined to surrender opinions or compromise principles he takes ample account of the "personal equation," and possesses unusual qualifications for making and keeping friends.

Mr. Lomax and Irrigation. Mr. E. L. Lomax, general passenger agent of the Union Pacific system, has a lively appreciation of the relation of irrigation development to railroad traffic. He is one of the most generous and persistent friends of the industry. He has been at work for some time past in compiling a book describing and illustrating the opportunities for settlement on irrigated lands along the line of the Union Pacific in Nebraska, Colorado, Wyoming, Utah, Idaho, Montana, Oregon and Washington. He will give the book a wide distribution. If all the influential railroad men in the West realized the importance of populating their territory as fully as do Mr. Lomax and a few others, the gain for the movement would be very great. It is to be hoped there will be some eminent conversions.



SAN MIGUEL STREET, SANTA FE, N. M.

By Permission of the New Mexico Bureau of Immigration.

MAJOR POWELL AND HIS WORK.

A FRIEND DESCRIBES HIS SERVICE TO WESTERN AMERICA.

THERE is a certain natural order of exploration and conquest of new land which has been followed in many countries. The first stage is geographic exploration, commonly accompanied by the execution of reconnaissance maps; in later stages the fauna and flora, and the primitive peoples, if such there be, receive attention; still later comes geologic reconnaissance, and finally detailed geologic surveys, with the development of agricultural, mineral and other resources.

The order of explorations, researches and surveys by the pioneer geologist and ethnologist of Western America, J. W. Powell, has conformed singularly to the general standard. True, it was the inspiration of ethnologic research that led him into the then unknown mountain land in the later '60's and earlier '70's; but the earliest work was geographic research, and its first fruits were reconnaissance maps. The descent of the Colorado canyon, the most adventurous bit of exploration in the annals of American history, was projected and successfully accomplished with the view of extending geographic knowledge; the estimates of distances, the determination of courses, and the measurements of altitude along the stupendous canyon walls were made with a view of constructing maps on which facts relating to plants, animals, aborigines and material resources might be shown—and with each stage in the exploration and mapping new and important facts came to light, and thus the scientific horizon of the explorer constantly broadened. Beginning a trained botanist, the unique flora and the varied relations between life on the one hand and soil and climate on the other, stimulated study and led to rich collections of plants and the construction of forest maps. The peculiar climate and its relations to the distinctive geography of the Rocky mountain region soon attracted observation, and thus the germ of the most important American generalizations concerning irrigation was warmed into life. Before, during and after the exploration of the canyon, the explorer came into intimate relations with the aborigines, acquired their tongue, and by their own firesides listened to their legends and myths. The echo of the guns of Sumter transformed the teacher into the soldier, but the roar of the cataracts in the canyons witnessed the more brilliant transformation of the soldier into the man of science.

The earlier explorations under the auspices of the Smithsonian Institution soon blossomed into the more systematic surveys of the U. S. Geologic and Geo-

graphic Survey of the Rocky mountain region, under the auspices of the federal government. During the progress of this work Major Powell more fully developed his plans for geologic research and mapping, for the development of the mineral resources of the Rocky mountain region, and for interpreting the forest areas as indices of possible agriculture. At the same time the irrigation problem was more fully developed. Up to the date of the absorption of this survey many important reports were published by Powell and his collaborators; his report on the arid lands first made known the actual agricultural condition and possibilities throughout a vast region; his report on the Unita mountains brought together in summary form a vast body of original observation and inference relating to geologic processes, set forth new principles by which the entire science was revolutionized, and suggested vast mineral resources which have since been utilized. His chief collaborators, Dutton and Gilbert, produced monographs recognized throughout the world as among the classics of geology. The survey marked the beginning of the American era in the development of geology. The idea of baselevel, which is now fundamental in all countries, the definite recognition of cause and effect in mountain-making, Dutton's law of isostasy, and the fundamental principles of vulcanism were developed in the progress of the survey. Powell's own recognition of and insistence on the existence of vast coal beds in the cretaceous was at first regarded as heterodox and incredible, but his conclusions were long ago verified.

GEOLOGICAL RESEARCHES.

When the survey of the Rocky mountain region was merged, with other governmental explorations and surveys, into the present U. S. Geological Survey, Powell was in the possession of a larger body of facts and principles relating to Western America and its resources than any other man; and when placed in charge of the new organization, this knowledge was utilized. The new survey was rapidly extended and modified. One feature of the plan was the extension of the surveys over the entire public domain, and this has been carried out with signal success. Another feature was the extension of topographic surveys over the country and the preparation of topographic maps to serve as a basis for the geologic researches and maps; and this feature, which was at first regarded as chimerical, was put into execution, and already more than one-fifth of the public domain has been surveyed and mapped with greater refinement than was thought

possible by any other man than the author of the scheme at the time it was broached. Another part of the plan was detailed geologic survey of regions specially rich in mineral resources. This design also has been carried out and has given to the world the most useful and elaborate treatises known to the literature of geology in the form of such reports as those on the quicksilver district and the gold belt of California, the Eureka district of Nevada, the Leadville district in Colorado, and the copper and iron-bearing districts in the Lake Superior region. These special reports, made by collaborators who were themselves geologists of world-wide repute, indicate the catholic policy of Director Powell. Throughout his career he has associated with him the ablest men to be found; in his descent of the Colorado canyon and other exploratory work he sought the strongest and most courageous assistants, regardless of other characteristics; as a scientific administrator he stands alone in choosing the most distinguished men of science as his coadjutors and official subordinates, and he has always rejoiced with them over the fruits of their labors, claiming no share for himself.

The influence of J. W. Powell on the development of western United States cannot easily be overestimated. His explorations and surveys began when the region was new and have continued to the present time; he was the first white man to visit some regions; he was the first botanist to consider the agricultural possibilities of the great West in a broad way; he has been a comprehensive American student of irrigation; he was the first to perceive certain important mineral resources that have since reached magnificent development; and his conclusions, often questioned at first, have nearly always been verified later, and have been published broadcast through personal communication, by innumerable lectures and thousands of letters, by newspaper accounts and interviews, as well as by official reports; and from first to last he has encouraged diffusion of knowledge on the part of his official collaborators to the extent that every division and section of the surveys under his direction have been instrumentalities for the diffusion of information relating to science.

ON WESTERN TOPOGRAPHY.

The topographic map of the United States now in progress by the U. S. Geological Survey owes its inception and the progress already made to Major Powell. It is strange that while the rest of the civilized world centuries before felt the need of maps and had been engaged in making them, this country, in other respects the most progressive of nations, should have taken no steps to supply itself.

The map of the country which was commenced by Major Powell was started, not because of the existing

need of topographic maps for general industrial purposes, but because of a specific need; that is, the geologists required a topographic base for the conduct of their work and the presentation of results.

In the twelve years during which this work has been going on, about 600,000 square miles, or a fifth of the area of the country, excluding Alaska, has been surveyed, at an average cost of about \$5 per square mile; that is, at a total expense of about \$3,000,000. This surveyed area is represented on 925 atlas sheets, 750 of which are engraved and printed. This rapid progress illustrates the vigor and energy which Major Powell has infused into this work by his admirable methods.

Major Powell's administrative work is strongly characterized by one feature which, probably more than all others, has conduced to its success. It is a very simple feature, and it is surprising that a larger number of administrative officers do not understand or appreciate it. It may be pretty well characterized by saying that he lets his men alone. His plan is to place duties and responsibilities upon his assistants to the fullest extent to which they are capable of carrying them. He does not meddle with details himself, but requires that they be looked after by persons properly charged with them. Every man has his field, his duties and his responsibilities, and he feels that he will not be interfered with so long as he is carrying on his part measurably well. Under such form of organization the Director's advice is sought instead of orders being received, interest in one's work is maintained at the highest pitch because it is one's own work, and the best quality and the largest quantity of work are assured.

It is especially with reference to the value of this map to the West, and more particularly to the irrigation interests of the West and its agriculture, that we are interested in it. Every irrigation enterprise is concerned with the knowledge of the surface of the ground, the catchment area of streams, the sites for reservoirs and dams, the location of ditches and the location of lands which can be irrigated with the greatest economy and to the greatest advantage. All of these are matters of topography, and upon them a topographic map throws much light. The Hayden Atlas of Colorado, in spite of its small scale and its many imperfections, has been no small factor in the phenomenal development which the Centennial State has enjoyed; but vastly more valuable are these maps of the Geological Survey, with their larger scale and much greater accuracy of detail.

In this connection it will be of interest to know what progress has been made in the mapping of the arid states and territories. This is set forth in the following table, which shows the total area of the

states and territories, the area surveyed to date, and the scale and contour interval of the map sheets.

State or Territory.	Total Area.	Area Surveyed to date.	Per cent. of total surveyed
Arizona.....	113,020	41,000	36
California.....	153,360	35,000	22
Colorado.....	103,925	34,814	33
Idaho.....	84,800	11,500	13
Montana.....	146,080	14,400	10
Nevada.....	110,700	20,000	18
New Mexico.....	122,580	27,860	23
Oregon.....	96,030	11,000	11
Utah.....	84,970	6,000	7
Wyoming.....	97,890	7,700	8
	1,113,355	209,275	19

Thus it will be seen that out of a total area of 1,113,355 square miles, 209,275 square miles, or nineteen per cent. have been surveyed. In addition to this nearly all of Utah had been surveyed by Major Powell prior to the commencement of work by the Geological Survey, and most of Colorado and large areas of other states and territories had been surveyed by other organizations, although these maps are on smaller scales and are of much inferior quality to those now being made by the Geological Survey, and are of course of very much less value to irrigation enterprises.

PROGRESS OF IRRIGATION.

Major Powell was probably the first man to call public attention by writings or lectures to the subject of the reclamation of the lands of the arid West by irrigation. As early as 1867, when he made his first trip to the West with a class of college students, he commenced the study of the problems which arid lands present. Prior to that time he had been a careful student and a college lecturer on physical geography, and in this connection he had considered and discussed the relation of lands to water supply, and had shown how the physical geography of certain countries was such as to enable people to carry on the pursuits of agriculture by means of the artificial watering of land. After his return from this first trip to Colorado, he commenced and has continued ever since to lecture both as a college professor and in public all over the country on the subject of the arid lands and their irrigation. During his various trips to Colorado, Utah, Arizona and Wyoming in charge of topographic and geologic surveys in 1868, '69 and the early '70's, he gauged the various streams in Utah and made a careful study of their capacities for water supply for irrigation. In 1878 he wrote his celebrated "Lands of the Arid Region," which was the first public document in which the subject of irrigation was broadly considered for the whole country. This report is practi-

cally the foundation work of all the irrigation writings and studies which have followed it.

In this report he recommended changes in the Land Survey laws, and suggested a re-classification of lands whereby they should be divided into irrigable, pasture and timber lands, and he has ever since advocated such a system of classification of the arid West. He submitted to Congress, through the Secretary of the Interior, in 1878, two bills, one entitled "A bill to authorize the organization of pasturage districts by homestead settlements of the public lands which are of value for pasturage purposes only," and the other "A bill to authorize the organization of irrigation districts by homestead settlements of public lands requiring irrigation for agricultural purposes."

In 1879 and '80, Major Powell was a member of a commission appointed by Congress on the classification and codification of the existing laws relating to the survey and disposal of the public domain. The other members of this commission were James A. Williams, Commissioner of the Land Office; Clarence King, United States Geologist; A. T. Britton, lawyer, of Washington, D. C.; Thomas Donaldson; C. E. Dutton, captain, U. S. Army. The results of the labors of this commission were published in four large volumes, and recommended to Congress changes in the method of land survey and classification. These changes would have been of the greatest benefit to the country, but it has been found as yet impossible to realize them, though efforts are still being made in Congress to that end.

Major Powell's writings on the subject of irrigation are probably more numerous, various and valuable than those of any other individual in this country, while he has lectured and given addresses before congressional committees, chambers of commerce and in public, which have wielded the greatest possible influence in the development of the resources of the arid lands. As a direct result of his efforts to attract public attention to the value of the arid lands, Congress finally passed, in 1888, a law creating an Irrigation Survey. The work of this survey continued for two years under the direction of Major Powell, and gave perhaps the greatest direct impetus to the development of the irrigation resources of this country that has resulted from any law or the work of any single public or private act. The reports resulting from this irrigation survey have shown clearly and in great detail the extent and value of the water supply of the arid region, and the area and character of the irrigable lands, and they have suggested many projects for the reclamation of these lands, some of which have already been inaugurated by private enterprise.



A VIEW OF THE ALESSANDRO AND MORENO VALLEY IN SOUTHERN CALIFORNIA.

A TYPE OF IRRIGATION INVESTMENT.

A REORGANIZATION OF THE BEAR VALLEY SYSTEM IN CALIFORNIA.

BY THE EDITOR.

THE Bear Valley Irrigation Company of California occupies a unique place in the history of irrigation investment. It was by no means the first enterprise of its class to find capital in eastern States and foreign countries, but it was the first and only irrigation company to enter the general market with large amounts of dividend-paying stocks. A few of our important canal systems have been constructed with the private capital of their owners. The rest have been built with the proceeds from the sale of bonds, which are admittedly the evidence of debts incurred in the interest of development. The Bear Valley Company alone has attracted large investments as the result of the payment of dividends, selling its stock upon a constantly rising market. Under these circumstances this enterprise was accepted as the best type of irrigation investment.

ITS INFLUENCE ON THE MARKET.

It would be interesting to trace, if such a thing were possible, the total amount of money invested, directly and indirectly, in irrigation and kindred enterprises as a result of the Bear Valley policy of paying dividends of eight per cent. upon its preferred stock and fifteen per cent. upon its common, but it is certain that the total would be very large. These dividends were quoted in nearly every prospectus distributed by promoters of irrigation projects, and the success of the great California corporation was heralded everywhere as conclusive evidence of the soundness of this new class of investments. Bear Valley obtained for its own and its dependent enterprises something like \$3,000,000. This came in part from New York and the New England States and in part from foreign countries, principally from

England, Scotland and Switzerland. It attracted that class of investors who seek security rather than extraordinary returns, and they paid handsome premiums for this stock, so that the large dividends represented only a reasonable return upon the investment. The list of stockholders in the company includes hundreds of people, their holdings ranging all the way from a single share to large blocks of stock. It is thus evident that Bear Valley won the confidence of the investing public to the merits of irrigation in the truest sense. It carried the new industry beyond the boundary of speculative opportunity to the solid ground of proved security and established profits.

THE FAILURE AND ITS EFFECT.

And yet, after creating a market for a new class of securities and becoming the accepted type of a new and promising industry, the Bear Valley Irrigation Company suddenly ceased to pay dividends, became entangled in law suits and judgments, and, early in December last, woke up one morning to find itself in the hands of a receiver. The event was one of far-reaching consequences. It affected not only those immediately interested as owners of its stock or patrons of its water supply, but it was felt wherever irrigation enterprises were in process of development and wherever irrigation securities were being offered for sale. It was felt for a time not only that the Bear Valley Irrigation Company had failed, but that the irrigation industry had failed. The disaster occurred in the midst of widespread financial panic, but the panic was by no means responsible for it. If it had been, then irrigation investment would indeed have disappointed the hopes of its friends, for the mountain stream continues to flow and the gardens and orchards to flourish when times are bad as well as when times are good.

Neither the company's income nor earning capacity was in anywise injured by the financial depression.

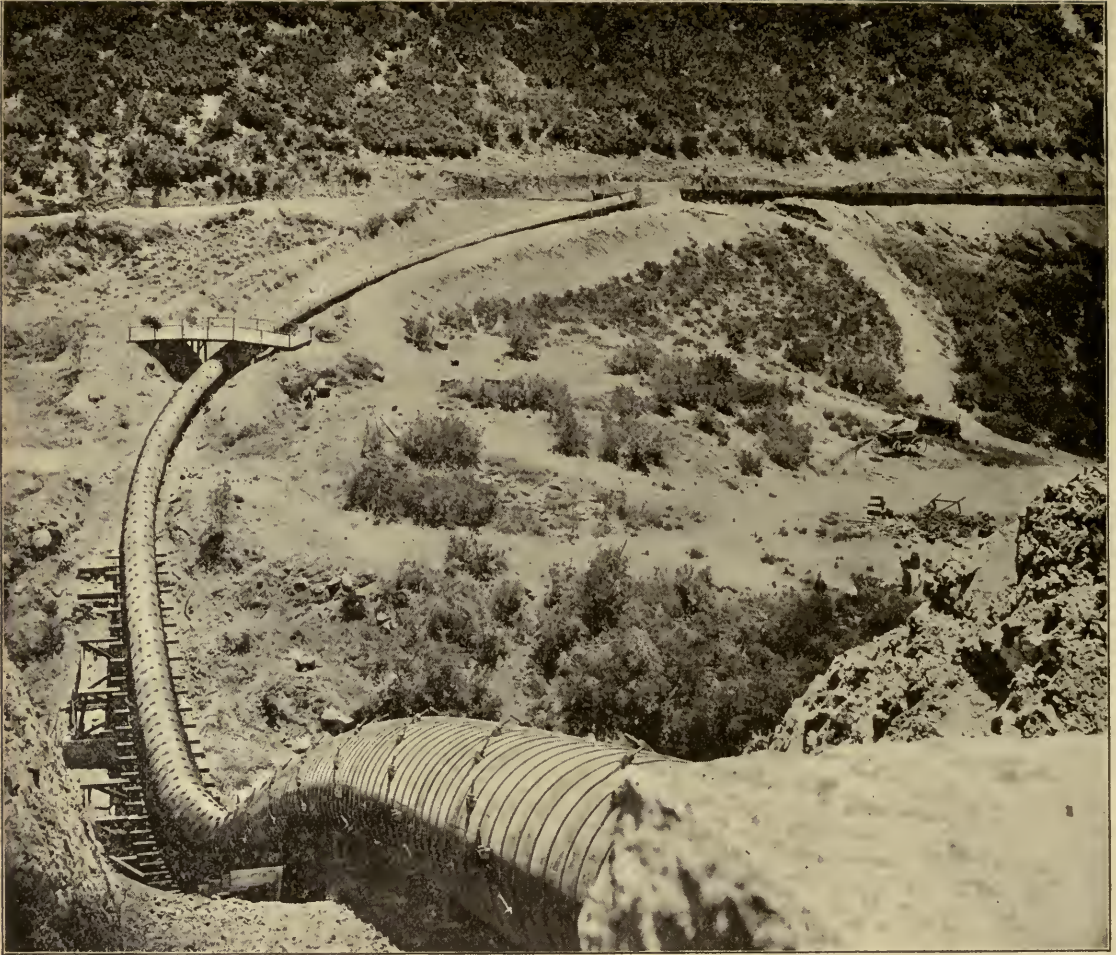
THE CAUSE OF FAILURE.

There is no difference of opinion concerning the causes of the failure among the many disinterested minds who have patiently and conscientiously studied its methods and its history, its values and its prospects. The Bear Valley Irrigation Company was wrecked by the under-development of its industrial opportunities and the over-development of its stock-jobbing possibilities. It would be unprofitable to enter now upon the story of its tortuous operations. Some time it may be interesting to discuss it as a remarkable reminiscence and to weigh the acts of individuals; apportioning among them the credit and discredit which was accumulated in a few brief years of extraordinary financiering, engineering and promotion. In the midst of much adventurous specula-

tion and unscrupulous manipulation, there was a good deal of creditable achievement. This is an aspect of the matter, however, not properly related to a consideration of the Bear Valley enterprise as a type of irrigation investment. What the financial world wants to know is the true value of a representative property in a new field of investment and industry. The millions which went into the enterprise were attracted by the strength of the general proposition that a large and certain water supply in an arid country furnishes exceptional security for capital, and that lands practically worthless in their natural desert state become enormously valuable when brought under a good system of irrigation. The philosophy which underlies all irrigation investments and the economic facts on which our new civilization in the West is being built up, were never more forcibly stated than in the attractive literature and convincing verbal presentation employed by the promoters of this typical enterprise. And it is this philosophy and these facts which are on trial to-day before the investing public. It is in this aspect alone that the present and future of the Bear Valley properties can be discussed with any real profit to the reader.

THE PHILOSOPHY OF IRRIGATION INVESTMENT.

Wherever the cultivation of the soil is a profitable pursuit, and such cultivation is impossible because of insufficient rainfall, the artificial application of water becomes a necessity. And yet within the lines of this simple statement there is a wide range for differing conditions. These may exist in localities separated only by a distance of a few miles. In one locality there may be an abundance of water, while the products of the soil are common varieties commanding comparatively small profits per acre. In another locality water may be scarce and difficult to control, while the products of the soil are very valuable. In both instances there is an opportunity for investment in works of irrigation, but the possibilities of profit will be much larger in one instance than in the other. Manifestly water must be most valuable where it is most scarce, and land most valuable where its products will earn the highest returns per acre. The element of security would be the same in both localities, but it would be much more pronounced where the provision of a water supply would create the largest values. The control of the water supply in such a neighborhood is practically a mortgage upon the productive energies of the entire community dependent upon it. No form of investment can be more secure than one guaranteed by necessary human industry. The higher conditions of irrigation investment are nowhere better illustrated than in Southern California. There land in cultivated orange orchards is worth

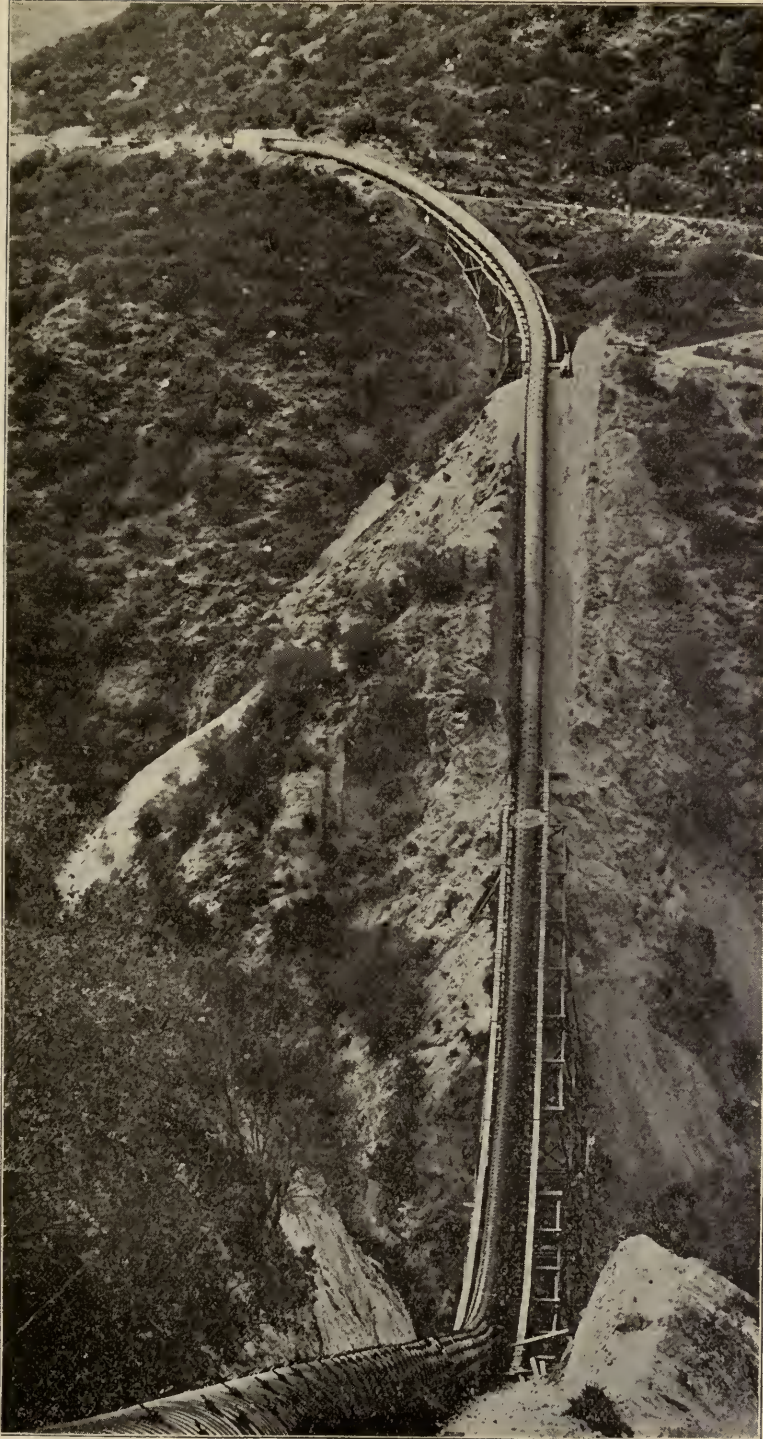


A WOODEN PIPE LINE OF THE BEAR VALLEY SYSTEM.

from \$1,000 to \$2,000 per acre. The annual net return is from \$250 to \$1,000 per acre. But this industry depends absolutely upon the water supply. The orchard is the child of the ditch. To say that dividends will not be paid upon the securities of a company supplying such a community with water, assuming that the works of that company are completed and its contracts fulfilled, is to say that these orange orchards, with their surrounding vineyards and gardens, are about to disappear from the face of the earth. The world existed for some centuries without railroads and telephones. When it learns to exist without the products of the soil, then prudent investments in properly managed irrigation enterprises will cease to earn reasonable profits, but not before. Briefly, this is the philosophy of irrigation investment in its general aspect. It remains for us to measure Bear Valley by this yardstick.

NEGOTIATIONS FOR REORGANIZATION.

The Bear Valley Irrigation Company passed out of the control of its managers December 9, 1893, when a receiver was appointed upon the petition of the Alessandro Irrigation district. The State court named Mr. F. P. Morrison of Redlands for the receivership, an appointment which gave general satisfaction, as Mr. Morrison is a banker and business man of high standing and thoroughly familiar with the property and its requirements. The property having been placed in good hands, the stockholders began to consider its condition and to formulate plans for its future with little delay. Early in January several meetings were held in New England, while the European stockholders appointed a committee to look after their interests. In view of the vital interest which the irrigation world in general felt in the outcome of the affair, the editor of *THE IRRIGATION*



SIPHON PIPE, BEAR VALLEY SYSTEM.

AGE was invited to participate in the negotiations begun in New York in January and continued in California and again in the east, from February down to the present time. The eastern stockholders appointed a committee to proceed to Redlands and confer with the receiver and representatives of the foreign stockholders. This committee consisted of Dr. Paul C. Skiff and ex-Senator James Graham of New Haven, with Hon. W. J. Heacock of Gloversville, N. Y. These gentlemen, at great personal sacrifice, devoted three months of the hardest and most trying labor and rendered services to their fellow stockholders which it would be difficult to overestimate. Their prominence in the communities in which they live is doubtless largely responsible for the numerous holders of Bear Valley stock among their townsmen. If they felt moral obligation to see their friends protected in their investment they certainly discharged it very fully in the course of the weary weeks in which they studied the constantly changing aspects of the situation.

MR. FOSTER'S GOOD WORK.

Mr. James Gilbert Foster of London arrived in Redlands in December as a representative of the European stockholders and was shortly followed by Mr. James Gardner Clark, a lawyer of New Haven, who had been retained by the same interest. The negotiations at Redlands and Los Angeles covered a period of nearly three months. From the beginning all parties concerned aimed to protect the capital invested in

the company and to render impossible the wrecking of the property in the interest of outsiders. The complications existing between the company and its creditors on one hand, and the irrigation districts on the other, were many and baffling. The work of unraveling these difficulties devolved principally upon Mr. J. G. Foster. He handled the delicate task with consummate ability, keeping faith alike with his foreign clients and with the local directors and the American friends whose assistance he sought or accepted.

IMPORTANT ARRIVALS AT REDLANDS.

The situation began to take definite shape when Mr. A. P. Maginnis, of Los Angeles, came forward with a proposition to interest a syndicate of prominent Chicago business men in the reorganized company. Mr. Maginnis cordially co-operated with the various elements in the situation and soon became their unanimous choice for appointment as one of the receivers at the hands of Judge Ross of the United States Court, to whose tribunal the matter was brought in February at the instance of foreign stockholders. In March the committees at Redlands were reinforced by the arrival of Messrs. Henry Allan of Glasgow and A. E. Davidson of Edinburg, and

Messrs. Edward F. Cragin and J. C. Shaffer of Chicago. The plans which had been formulated by weeks of negotiation were then finally shaped and put into operation. In the meantime Judge Ross had named Messrs. A. P. Maginnis and J. A. Graves as receivers, and they had begun a vigorous administration of the property. Their report showed the total liabilities to be over \$1,250,000, and that an equal amount would be required to complete the plant, making a total requirement of \$2,500,000 of new capital.

A JURY FOR BEAR VALLEY AS A TYPE.

The time came about the middle of March when this representative enterprise, whose success had largely won and whose failure had largely impaired the confidence of the public in a new class of securities, must submit to the crucial test of examination by impartial minds. To a large degree the broad subject of irrigation investments was on trial in this case. The party gathered at Redlands included keen European minds representing the most conservative element of foreign investors; men of ripe judgment from eastern States accustomed to rigid standards in the estimation of values and earning capacities; men



BUILDING A FLUME ON THE BEAR VALLEY SYSTEM.



A CEMENT DITCH, BEAR VALLEY SYSTEM.

of large affairs from Chicago, who are in the habit of penetrating financial propositions to the core; Californians thoroughly familiar with all the local conditions related to the value of land and water; lawyers specially skilled in the legal questions involved in the complicated affairs of the company and the plans proposed for its reorganization. Still other parties to the conference brought to its councils broad knowledge of irrigation in its world-wide aspects and were

able to compare this typical enterprise with all others of prominence in various western States and Territories. This was the character of the jury which passed upon the merits of Bear Valley, and weighed in its scales the various elements which enter into the problem of irrigation investment. The examination was thorough, rigid and merciless. The result, as will be seen, was the triumphant vindication of irrigation securities as a class.

A MANY-SIDED SUBJECT.

The Bear Valley irrigation system is a many-sided subject. A chapter might be written on its bold and successful engineering, which has passed into the literature of the profession; another on the character of the irrigation methods it has introduced, which are unquestionably the most perfect yet adopted in the world; another on the character of the communities which have been built up under these beautiful canals; and still another, and this of absorbing interest, on the history of the development of the enterprise in its various phases. But at this time the public is interested chiefly in the financial outcome of the project, and in the effect which it will have upon the future of the industry. The examination of the system began with an inspection of the reservoir and dam

in the top of the San Bernardino mountains and ended with the closest study of land and water values in the beautiful valleys to which this water is conducted through river bed, pipes, flumes, tunnels and canals. It included a careful consideration of every item in the list of liabilities and estimates of construction, as well as the cost of administration when the entire system shall be complete.

PROVING THE CLAIMS OF IRRIGATION.

All the fundamental claims of the advocates of irrigation securities were verified, as a result. The most important of these relates to the value of water in an arid country. The investigators did not have to go far to satisfy themselves fully on this point. There lay Redlands, a realized ideal of a beautiful community, based on small tracts of intensely cultivated land. Lying on a sunlit slope, framed by noble scenery, every acre utilized for orchards and gardens, every home an evidence of prosperity, and every street and door-yard green with vegetation and fragrant with the perfume of flowers. In the valley, eternal summer; in the mountain tops, eternal winter; and every element of value which these things represent to man, the creation of water applied by a system of irrigation. It is only seven or eight years since the occupants of this same sunny slope objected to a valuation of seventy-five cents per acre upon this land, then only valuable for the pasturage of sheep. To-day the same land is worth from \$1,000 to \$2,000 an acre, and even more in some instances. This valuation is absolutely dependent upon the water supply. There could be no question, then, about the value of the water supply. Across the range of picturesque hills lay the Alessandro and Moreno tracts, only awaiting the completion of this system to blossom like Redlands with the homes of men, and intending, if possible, to improve upon the parent colony. But the territory now immediately dependent upon the system by no means measures the demand for Bear Valley water. This is the only large supply in a locality where the demand for water is extraordinary. Between Redlands and Los Angeles there are thousands of acres which are ready and willing to contract for every inch of surplus water that can be developed. It is this demand which will fix the selling price for the water to be impounded in the various reservoirs of the company. This investigation of the value of water also demonstrated the value of the large bodies of lands which belonged to the company.

GREAT MATERIAL ASSETS.

A careful study of the company's resources showed the following values over and above the magnificent plant itself:

10,000 acres of the best land.....	\$2,000,000
Unsold water rights, available upon completion of plant.....	1,380,000
District bonds.....	500,000
	<hr/> \$3,880,000

The company's earnings will be as follows:

From existing contracts.....	\$207,500
From annual charge on surplus water rights.....	127,500
From interest on district bonds.....	30,000
	<hr/> \$365,000

To this there will be added nearly \$200,000 for a period of many years as interest on notes and mortgages resulting from the sale of the lands. A further addition--indefinite but certain to be very considerable--must eventually be added for the earnings from a magnificent water power remarkably adapted to electrical development.

These estimates of values and earning capacities were arrived at after a most patient study of the engineering problems involved and of land and water values under the system and its immediate vicinity. The figures have the endorsement of the financiers, lawyers and experts engaged in the examination of the property and the formulation of plans of reorganization. There is every reason for confidence in the announced expectation of retiring the bonds within ten years and paying moderate dividends upon the stock--dividends that will necessarily increase steadily for some time to come and eventually justify a premium price for the stock.

THE NEW BEAR VALLEY.

The plan of reorganization includes the formation of a new corporation to be known as the New Bear Valley Irrigation Company. Its capitalization is placed at \$4,000,000, all of which will be represented by common stock. It is proposed to issue bonds not to exceed \$2,500,000 to provide for the liquidation of the indebtedness and the completion of the works. It is proposed to push construction rapidly to completion, thereby fulfilling all existing water contracts and providing a considerable surplus water supply upon which certificates will be issued and sold to meet the insistent demand of those who desire to become actual consumers.

SAVING OLD INVESTMENTS.

In the new organization there will be no trace of the old management, although it is probable that nearly all the old stockholders, American and foreign alike, will become stockholders in the new company. They will be reinforced by a large representation of new American capital, together with some from abroad. From the beginning of the negotiations the effort has been to formulate a plan which would enable those who had made a genuine investment in the old company to protect themselves and share in the benefits and profits of the enterprise. The plan finally determined upon provides terms upon which this most desirable object can be accomplished. Those who accept it will be able to save every dollar of their original investment on generous terms involving no risk of the new money they shall invest.

A VINDICATION FOR THE INDUSTRY.

The new company will be under the responsible management of some of the strongest American and European men of affairs. The Chicago capital, which

joins with the old American and European investors in the enterprise, represents some of the most substantial and successful men in that great city. Surely there could be no better guarantee than an enterprise sadly mismanaged and over-manipulated in the past will hereafter realize the highest possibilities of sound business sagacity applied to extraordinary opportunities. The Bear Valley system stands to-day and will stand in the future, as it was popularly believed to have stood in the past, the true type of American irrigation enterprise at its best. It delivers more valuable water to more valuable land than any other system on the continent. Its works are the product of the finest engineering ability that money can command. Its lands are in the very heart of that portion of Arid America where the cultivation of the soil brings the largest return, and where the assurance of high and rapid development in the making of communities is the most certain. The future of the new company seems very bright indeed, and we are pleased to believe that it carries with it the assurance of prosperity to irrigation investment in general. No severer tests can ever be applied than those which irrigation has successfully passed in this instance. The triumphant result should be reassuring to all who are pushing irrigation development and to all who have invested in this class of securities. It is this aspect of the matter which chiefly interests the readers of *THE IRRIGATION AGE*.

WHAT IT MEANS TO SOUTHERN CALIFORNIA.

The announcement of the settlement of Bear Valley affairs will be received with immense satisfaction in Southern California. In the districts immediately interested this satisfaction will amount to joy. To lose an investment is a misfortune, but to lose a water supply where land is valueless and existence impossible without it is a calamity. One need not have the gift of prophecy to predict great things for the localities under the Bear Valley system in the early future. Alessandro, Moreno and Perris cannot escape a wonderful impulse of development. There is no place in the West where those twin forces, irrigation and electricity, will work more surprising results than in this immediate vicinity. The people of these com-

munities have suffered much from delay and uncertainty. We believe they are about to be rewarded with a degree of prosperity never realized before in Southern California, and best of all, this prosperity will rest upon things that are substantial and enduring.

AS TO MR. JAMES GARDNER CLARK.

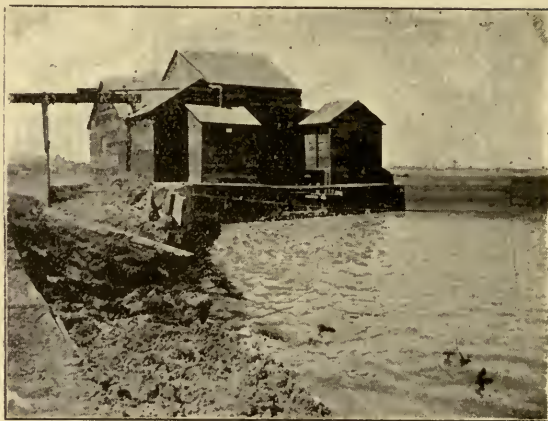
So far as the writer has learned there is but one party to the recent negotiations who expresses dissatisfaction with the outcome. This person is Mr. James Gardner Clark of New Haven, Conn., who has already been referred to as having been engaged at one time to represent the foreign interest. Mr. Clark happened to be in England at the time the company became embarrassed. He had been somewhat familiar with its affairs from the beginning, being related by marriage to its original promoter. Mr. Clark has stated that "it is a remarkable psychological fact" that he was engaged by the English parties after an acquaintance of only twenty minutes. As soon as his English friends became better acquainted with him they decided to get along without his services. Mr. Clark has not stated to what realm of facts this latter event belongs, but it does not appear to have anything to do with psychology. These remarks are rendered pertinent by the fact that Mr. Clark has announced his intention of going to England to defeat the plan of reorganization. He has stated in letters to parties in London that the reorganization is wholly in the interest of stockholders in the old development company, an element to whom Mr. Clark (when in England) is violently opposed. In the meantime Mr. Clark (when in Redlands and New Haven) assures this same element that he is their guide, philosopher and friend. We are informed that his correspondence on both sides of the question is in existence. Certainly there are sufficient witnesses to his verbal expressions. He is therefore in a position to truthfully tell the English that he is opposed to the American stockholders, and with equal truth to tell the Americans that he is opposed to the English. In view of these facts there is little reason to fear that Mr. James Gardner Clark will be taken seriously by the European public.

A UNIQUE WYOMING WATER MOTOR.

BY J. A. BRECKONS.

F. H. HARVEY, a Douglas, Wyo., lawyer, has apparently solved the irrigation problem for the Platte valley in Wyoming. The Platte river is one of the largest streams in Wyoming, which by nature of the peculiar topography of the country through which it passes has not been utilized to any extent for irrigation purposes.

The low banks, loose soil, shifting bed and current, have prevented taking out ditches by ranchmen of moderate means. Ditch enterprises involving the expenditure of sums running into the hundreds of thousands have been contemplated, but the necessary capital could not be secured, mainly, because of the inadequate security offered the investors under the present land laws. Consequently, along the Platte river for the hundred or more miles of its course in Wyoming are upwards of 350,000 acres of valuable bottom lands, unimproved and unoccupied, while



VIEW OF PLANT, LOOKING DOWN STREAM.

in short riffles. Below the riffles, on either side of the stream, are the bottom lands laying with a gentle slope to the river and admirably adapted to irrigation.

Mr. Harvey has located his motor on one of these riffles, three miles above the town of Douglas, and is now watering 200 acres with it. The motor has sufficient capacity to water 500 additional acres. The river at this point is about 850 feet wide and makes a sharp curve at the head of the riffle. A low dam of piles and loose stone starting at the head of the riffle was first constructed diagonally from the right bank of the stream to a point about 150 feet from the left bank. From the end of this dam a strong wing dam 10 feet wide and 12 feet high, made

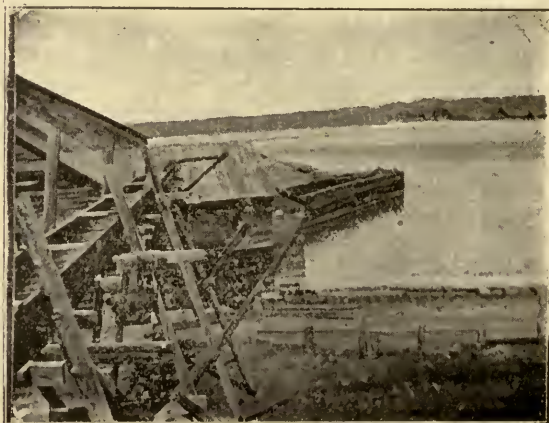


VIEW OF PLANT, LOOKING UP STREAM.

passing by it was the Platte river, carrying at high water 15,000 cubic feet per second of the water which would make these uninhabited tracts of waste land bloom like a tropical garden.

Many schemes have been tried by ingenious ranchmen to raise water from the river to the land, but to the present they have been failures. That of Mr. Harvey, however, is a success, and the practical demonstration of its cheapness, simplicity and ability is going to work at once a revolution in the Platte valley and along all other streams in the west of like characteristics.

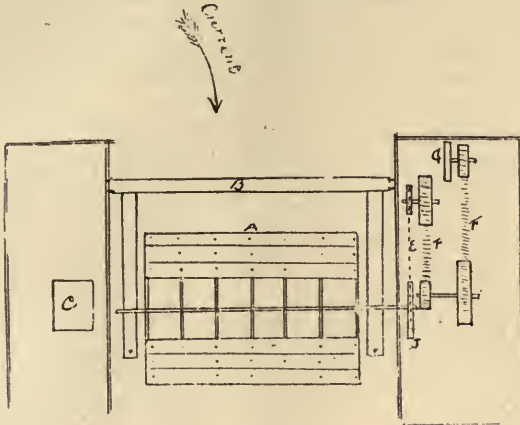
The Platte river in its course through Wyoming, alternately runs in almost level stretches of several miles and then in rapid falls of from 30 to 60 inches



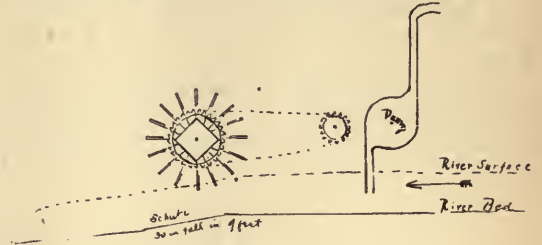
VIEW FROM TOP OF PLANT.

of piles, plank and loose stone, was built, extending at an angle of almost 20 degrees towards the shore for 50 feet, and then for 12 feet directly down the stream parallel with the shore. A similar wing dam was constructed from the shore, the two forming a

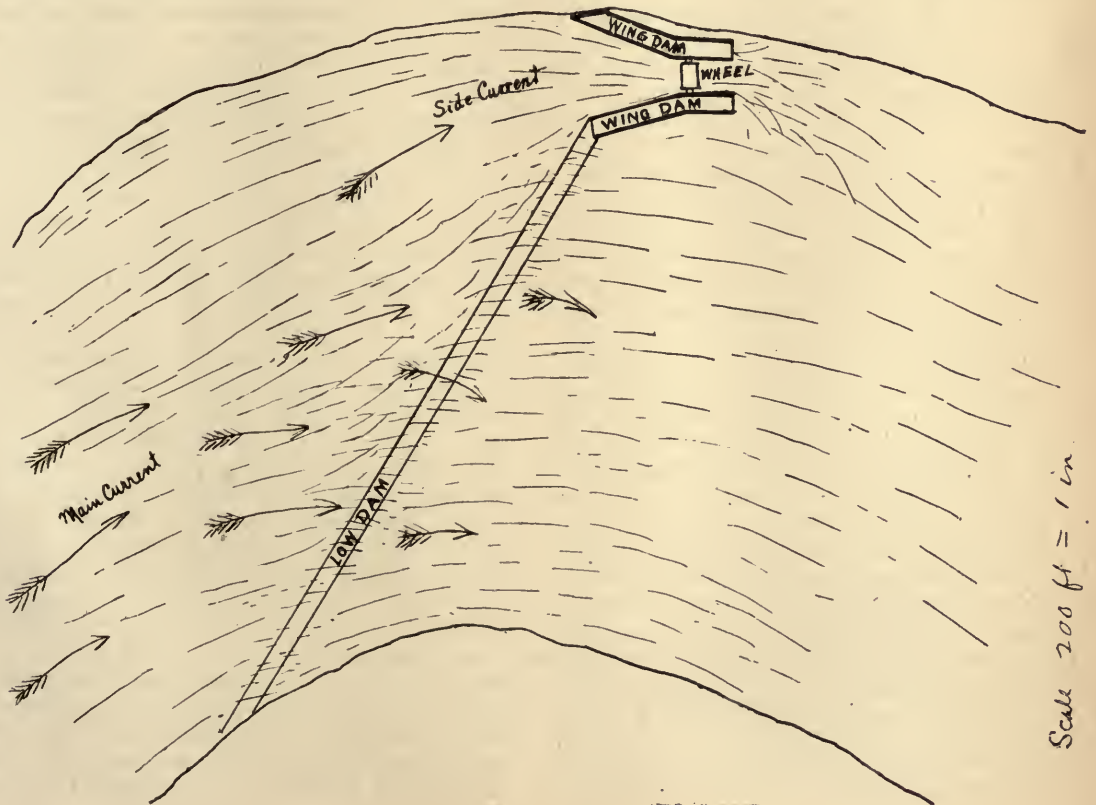
tion of an undershot and breast wheel. The thirty inches of fall which the river makes in the riffle is concentrated in the chute carrying the water through the Y. With a 10-foot diameter wheel, 14 feet long, 60 horse power is secured. This in the Harvey plant is used at the present time to run a $3\frac{1}{2}$ -inch centrifugal pump which raises 1,000 gallons of water per minute a height of 16 feet. The



letter Y, with the stem extending down stream. The main current of the stream passes over the low dam, but a side current is directed by it into the Y where the water wheel is placed. The wheel is a combina-



same power will run a 5-inch pump, raising 7,000 gallons per minute. The wheel is hung on a swinging frame and is balanced by a counter weight. Its gearing is a sprocket wheel so that it can be raised or lowered with the varying rise or fall of the river without any readjustment of gearing. Logs have been run under it and it has ridden over them like a



pneumatic-tired bicycle passing over a rail or stick without injury to the wheel or jar to the pumping machinery.

The wheel was started on April 17th, a large party of Douglas citizens being present, and has been run continuously day and night since that time at an expense of about ONE CENT per day, this expenditure being for oil on the pump connections. No engineer or watchman is needed and the wheel works on while the owner works in the field or sleeps, every 24 hours pouring 1,440,000 gallons of water on the thirsty land.

The cost of the wheel, compared with what it accomplishes, is nominal. Labor and material, including the pump on the Harvey plant, amounted to

\$1,200. As much of the work was experimental it was necessarily slow. A like plant can be put in for \$800, and most of the work can be done by the ranchman himself.

Since the wheel has been running scores of ranchmen have visited the plant and preparations are already being made to put in four plants at various places along the river, one of them, where the rifle has a fall of 50 inches, to be of 100 horse power.

Mr. Harvey will not undertake to patent any feature of his motor, and will cheerfully furnish information as to its construction to anyone. The enhancement in value of his own property, and the satisfaction of seeing central Wyoming develop, is all the reward he wishes for his invention.

THE ART OF IRRIGATION.

FIFTH PAPER: METHODS OF THE CHINESE AND ITALIAN MARKET GARDENERS.

BY T. S. VAN DYKE.

IT is probable that the Americans would some day have learned to irrigate well without teachers. But it is equally certain that until he saw the Chinaman irrigate the noble white man of the great west rarely suspected that he was losing time and money and breeding mosquitoes, weeds and malaria through ignorance of some very simple principles.

Most all the Americans who at first tried raising vegetables on the Pacific coast decided that the coast was not adapted to vegetables, while others concluded it was cheaper to go without them. Occasionally a waxy potato with a cave in the center was seen upon the ranch table, but generally the festive bean was the only approach to a vegetable. They used to say that it was too much trouble to raise vegetables, did not pay, etc. The fact was they had nearly all tried it and could not do it. The Chinaman and Italian were both pretty good irrigators with methods very much alike. Though they can both be beaten to-day in orchard and vineyard work by the more progressive of the American population, there are few if any that can surpass them in market gardening.

The Chinaman was generally the better irrigator. His methods seemed numerous but could all be reduced to two; soaking the ground from furrows and flooding it by small dams or checks. To-day the Chinaman uses, or rather wastes, more water than the American; but at first it was the other way and the small quantity of water the Chinaman used surprised the American. For the first time the American saw the ground leveled up so that the water in each check would stand at about the same depth.

The idea penetrated the Saxon's wool at once. Why had he never thought of it before? In this way the water could be put on in a sheet so thin that there would be little sediment deposited; the water would be clear and quickly soak in, and there would be little if any pressure upon the ground; of course this took some work. But for a garden patch it amounted to little and as the checks did not have to be so high as in a field, there was some compensation. Moreover the principle could be approximated in orchards even where it would not pay to duplicate it.

The Chinaman and the Italian wherever convenient kept the water away from the stem or stalk of everything. Many tough things like onions, beets, carrots and turnips he had evidently learned could stand it. He therefore planted them in checks, sometimes very thick; at other times in rows very close together. But there was method in this and it varied with the nature of the soil. Where he let the water come in contact with the stalk it was generally where the ground was sandy and the thin sheet that he spread over the leveled ground would soak in so quickly that no baking of the ground would follow. In no case was the baking very bad, and if the soil were such that it was liable to be bad then he planted in rows so that he could break up the ground between.

But there were other things that the Chinaman knew would not do well if the water touched them. Some, like potatoes, would not be hurt much if care were taken to prevent baking, but others, like melons and beans, evidently suffered if the water touched them at all. The Chinaman therefore

planted nearly all his corn, melons, beans, peas, potatoes, egg plants, and all valuable stuff in long rows, while spinach, beets, lettuce, radishes, beets, to be used as greens, and simular stuff, he planted in checks helter skelter. But however planted in the checks he generally weeded them out for sale as they grew, leaving the rest so that they could be cultivated. And where it was just as convenient to keep the water off the stem entirely the Chinaman did so with everything.

This was probably the first the American heard of this principle, for the native irrigators of California seem never to have applied it and probably never knew it. Afterward, in its application to trees, like the orange and lemon especially, the American found it of far more importance than even the Chinaman had suspected. There are cases where it must of course be ignored, as in irrigating grain after it is up. But the principle holds good even here. If not irrigated too often the grain may do well in spite of it; but it would do still better if the water could be kept away from the stalk entirely.

When the Chinaman irrigated with furrows the white man learned still another lesson. He found that it did not need a raging torrent to soak land, but that a small rivulet running clear or nearly so and running a longer time was much better. Though the Chinaman did not know the full extent of this principle, and has hardly learned it yet, he was a long way ahead of the age when he came here. For the first time the American saw the furrows made straight, tolerably smooth and even inside, and with some approach to an even grade. The water flowed through them at about the same speed in all parts. It formed no swamp here and left no dry ridges there. It was either clear or so nearly so that it did not puddle its channel much with sediment as it went along, and thus stop the soaking sidewise and downward.

The furrows were made, too, with some reference to the size and age of the stuff to be irrigated. The Chinaman did not fire as big a volley of water down between two rows of springing beans as he did among some tough old blackberry bushes; he sent, rather, a small creeping stream, a little distinction that the American had thus far not thought of. The furrows, too, were laid out on such a grade that the velocity of the water was low, and there was no cutting or tearing of the furrows; and they were made with such care that there was little or no breaking from one into the other when he had turned the water from the main ditch or feeder at the upper side of the field into the numerous small furrows that carried the water among the plants. He did not lean over the fence and talk finance with some neighboring granger, but with bare legs and hoe in hand he watched the small streams

and regulated their flow out of the main ditch so that one was not too small and the next one too big. This is now done much better than he did it, for he never thought of any connection between the two but earth, which is very hard to keep in place under running water. But up to the coming of the heathen anything like a regular feed from the mains into the laterals was unthought of.

I dislike exceedingly to insinuate that my countryman did not know anything about irrigation, but there is strong ground to fear that he had no idea of the utility or necessity of cultivation combined with the use of water until the Chinaman and the Italian taught him. This was certainly so in California. The Mexicans have no idea of it, and it is likely that what is known of it in the interior of our country was largely acquired by way of this coast.

It is not many years since it was a well established principle with many that cultivation made the ground dry out more quickly. It certainly dried more quickly at the surface, especially when the wind was blowing. I well remember hearing farmers back East when I was a boy contending that plowing the ground made it dry out quicker because it let the air in. It is now well known that cultivating the surface to a certain depth checks the capillary attraction by which the water from the soil is brought to the surface and evaporated. It acts the same as a mulch of sawdust or tan bark and retains moisture for weeks and even months after uncultivated ground beside it is perfectly dry.

But in the early irrigation of the United States this principle was little known and still less cared for. The old-time remedy, more water, was at hand and was much easier. Still less was known of the importance of aerating the ground. The consequence was that almost everywhere it was left as hard as a brick except where it was scratched up to admit the seed.

But the Chinaman and Italian knew better than this, though they did not know the full importance of the principle, and never carried it as far as it has since been carried by their pupils. As soon as the ground was dry enough to allow it to be stirred without making clods they broke it up. On a small scale they did this with a hoe, or a narrow rake, or some sort of a digging implement, and on a larger scale they used a small plow or the cultivator that the white man kept for sale but never used. Sometimes he did not cultivate at all but planted the seed in rows ridged up so high that the water could not possibly reach the stalk of the plant. The water ran in a narrow furrow between two broad high ridges and soaked upward as well as sidewise. This kind of work may still be seen and works fairly well for some things. If the furrows be filled with straw or some kind of a mulch it is better, but it was never as good for any-

thing as lower rows farther apart with the soil thoroughly stirred between after each irrigation. The amount of produce the Chinaman got from an acre of ground, as well as the quality of it, was a grand surprise to the American whose garden had more weeds than anything else, and was as hard as the floor of a brickyard unless irrigated every few days. Some contented themselves with saying that there is no use in trying to compete with the Chinaman because he can work so cheap; others said that gardening was too small potato business for them anyhow, beneath the dignity of great rancheros. So that in this particular line the Chinese and Italian gardeners had few imitators. But the men who were trying to raise fruit on a large scale, especially in the south, began gradually to open their eyes and imitate the methods of the men who came from the oldest irrigating countries of the world. More care was taken to make the streams even in size and velocity and there was less cutting and tearing of the soil, less washing new sand bars here and making new channels there. Cultivation was quickly adopted instead of drenching the soil again with more water, and it was not many years before the American had carried cultivation far beyond where the Chinaman had thought of carrying it.

The Chinaman and Italian apparently thought that when the ground was once loosened it needed no more stirring until it was wet again. This is the common impression even now among most of the white cultivators who have not studied the object carefully. They think the word *cultivate* is derived from *cultivator*, to cultivate being to drag a machine called a cultivator over the ground. One application complies with the demands of derivation. One scrape of the top soil is all that many of them ever think of. Experience has shown that that one scrape is very good, but it has also shown that several more are very much better. No matter how thoroughly the soil may be pulverized, or how deep it may be done, from the very day it is allowed to rest and settle it begins to lose the power of retaining moisture. If stirred every few days, even though at each stirring new moist earth is brought to the immediate surface to be dried out, it retains moisture better than if reliance is placed on one stirring. It is thought by many that it absorbs moisture from the air. It is not necessary to settle this point. The fact is that if the soil be constantly stirred to a depth of four or five inches it will retain about all the moisture that capillary attraction will hold in that soil until the roots of the trees or vines extract it. And it matters not how hot a sun or dry an air may be over it during all that time. I have seen ground in November on which not a drop of water had fallen since April,

that five inches below the surface was moist enough to pack into a ball in the hand and moist enough for any kind of vegetation. And this where it was sixty feet to water beneath and with the sun beating on the ground for six months with scarcely a day's intermission. But this was on ground bare of vegetation. Had it contained trees a few years old with roots trained outward as they should be into the rich warm top soil all the moisture would have been gone in six weeks. And old trees in full bearing will often take it out completely in four weeks.

More of the great success attained by the skillful irrigators of Southern California is due to their thorough cultivation than to any other one point. It is certain that almost in exact proportion to their progress in pulverizing the top soil and keeping it pulverized they have produced better fruit and more of it with less water, less work and less worry. In some of the settlements you may now ride for miles in the summer without seeing a weed or even a spear of grass in the orchards. The top soil to the depth of four or five inches is kept like meal. In some places the cultivator hardly ever rests, but is started crosswise as soon as it has finished the field lengthwise and *vice versa*. The plow is not used because it runs too deep. In the best orchards the roots are purposely trained high and outward so as to be where the soil is warm and easily aerated. The cultivator used is generally some variety of disk cultivator or clod cutter. But the variety is not so important as its use. Mashing the clods with a big drag or plank is all very well if the ground is again broken up with the cultivator. But few things are more stupid for many soils than leaving the top of the ground smooth after the drag has gone over it. Many do this imagining they have discovered something new. It is now certain that the looser the top soil the more it acts as a mulch. Everything that packs or settles it in the least makes it lose to some extent, although it may be small, its power of retaining moisture.

It is now certain that cultivation produces much of its effects by aerating the ground. The soil must have air and the best results are impossible without it. Worse than this. Fairly good results are impossible without it unless on soils so open as to be naturally warm and well drained and so open as to admit air, hence what in tillage of the soil under a good rainfall is an undoubted advantage, becomes with irrigation a necessity. It is probably a necessity for the best results under a good rainfall, but as to its office in irrigation there is now no room for doubt.

[This series of papers on the "Art of Irrigation" was begun in the January number, and will be continued for several months to come.—EDITOR.]

IN REPLY TO POWELL: THE DUTY OF WATER IN ARIZONA.

BY W. A. HANCOCK.

MAJOR J. W. POWELL, in his paper in THE IRRIGATION AGE, for February, has evidently aimed to sustain his assertions before the Irrigation Congress at Los Angeles, and in so doing has fallen into some very grave errors. In the interest of Arizona in particular, and the Arid West in general, I propose to give him and his paper a little attention.

AMOUNT OF WATER REQUIRED.

Under the head of "The Amount of Water Required" he says: "Grass growing in turf will transpire in one day a weight of water as great or greater than the weight of the dried grass," and he enumerates a number of vegetables, cereals and perennial vines and trees, that will likewise "exhale every day a weight of water equaling the weight of the dried growth of the year." Further on he says, "Thus a ton of hay requires 100 tons of water for its growth, and an acre of grass that will make two tons of hay will require 200 tons of water." "An acre inch of water weighs 226,600 pounds, or about $11\frac{1}{3}$ short tons."

The truth is that an acre inch of water contains 3,630 cubic feet and at 62.3 pounds per cubic foot, it weighs 226,149 pounds, or 451 pounds less than Major Powell states, but it is 11.3 tons instead of $11\frac{1}{3}$ tons, and hence the acre of grass will transpire only 1.77 acre inches of water, instead of 18 acre inches, as Major Powell claims. If the crop of grass transpired 18 acre inches during its growth, it would transpire 2,034 tons instead of 200 tons, or 1,000 times the weight of the dried crop instead of 100 times.

Major Powell makes the absolute duty of water what the crop will transpire during its growth. As a result, after eliminating his errors, the absolute duty for the crop of two tons would be 1.77 acre inches: Add to this his allowance for evaporation and waste, 6 acre inches, and the practical duty is 7.77 acre inches, instead of 24 acre inches as he claims.

Remember, I do not claim this to be the practical duty of water, but I say that it results from his theory, after eliminating his errors. To follow his theory a little farther, he says the absolute duty of water is what the crops transpire, and that in applying this water under economic conditions the loss by evaporation and waste would be 6 acre inches, which must be added to the absolute duty to make up the practical duty; and I will assume that this rule will apply as well after eliminating his mistakes about the absolute duty, so that the practical duty should be the

transpiration of the crops, 1.77 acre inches plus the 6 acre inches, for evaporation and waste, or 7.77 acre inches, and all water applied over and above this would be an injurious duty under his rule. Now, let us consider a practical test of the question, in central Arizona.

AS APPLIED TO ALFALFA.

The principal plant relied upon for hay is alfalfa. By the 1st of March we give it an irrigation of 4 acre inches, $452\frac{1}{4}$ tons of water per acre. In 50 days we cut it, and realize $1\frac{1}{2}$ tons per acre. By the 1st of May, it is again irrigated with 5 acre inches of water, $565\frac{1}{3}$ tons per acre. In 45 days we again cut $1\frac{1}{2}$ tons per acre. This process we repeat 3 times more, cutting the last crop about the 5th of November. The total amount of water applied is 24 acre inches. If we deduct 6 acre inches for evaporation, we have 18 acre inches, Major Powell's mistaken duty for one crop of 2 tons, and we have cut 5 crops, making $7\frac{1}{2}$ tons per acre. The weight of 24 acre inches is $2,713\frac{3}{4}$ tons per acre. If the transpiration is 100 times the weight of the dried crop, and this is the absolute duty of the water, then it is 750 tons per acre, or 6.66 acre inches, and the evaporation and waste is $1,963\frac{1}{4}$ tons of water per acre, or 17.34 acre inches.

Take the result of one cutting that is produced in 45 days with 5 acre inches of water, and the transpiration would be 150 tons per acre, or 1.33 acre inches, and the evaporation and waste $414\frac{1}{3}$ tons per acre, or 3.67 acre inches of water. For another illustration of the practical result, I will take a crop of wheat or barley: It may be sown from October 1st to February 15th following, and will be cut from May 10th to July 1st, but its growth is principally in February, March and April—say 90 days. It is ordinarily irrigated 3 times, applying altogether 14 acre inches, or 1,583 tons per acre.

The dried crop, grain and straw, will weigh 2 tons per acre. The transpiration being 100 times the weight of the dried crop will be 200 tons per acre, or 1.77 acre inches, and the evaporation and waste must be 1,383 tons per acre, or 12.23 acre inches.

Now, one more illustration of the practical test on this subject: After our wheat and barley are removed, from the 20th of June to the 10th of August we can plant corn on a large proportion of our soils with a certainty of producing a profitable crop, if we are diligent and have the water to apply. To pro-

duce the crop will require 15 acre inches, or 1,696 tons of water per acre. The crop when dried will weigh 3 tons per acre. Again applying Mr. Powell's rule that the growing crop will transpire 100 times the weight of the dried crop, and the transpiration will be 300 tons per acre, or 2.65 acre inches, and the evaporation and waste 1,396 tons per acre, or 12.35 acre inches. I will say here, further, in regard to the irrigation of alfalfa, some soils will take an irrigation of 12 acre inches in February and March, after which 3 crops, making 5 tons per acre, may be cut without further irrigation. Following the same general rule the transpiration would be 500 tons per acre, or 4.42 acre inches, and the evaporation and waste would be 856 tons, or 7.58 acre inches. A second application of 6 acre inches of water, 678 tons per acre will produce 2 tons more of hay, and the transpiration would be 200 tons, or 1.77 acre inches, and the evaporation and waste will be 478 tons per acre, or 4.23 acre inches.

NOT ABSOLUTELY CORRECT.

I must remind the reader that I do not make these statements of the duty of water as absolutely correct. There are variables here in central Arizona that I do not pretend to account for or explain. It follows from Major Powell's theory that the absolute duty of water is the amount which the crops produced will transpire while growing, and that the general rule is, that the transpiration will be 100 times the weight of the dried crops. Then by this rule, for the one crop of alfalfa produced with five acre inches of water, the transpiration is 1.33 acre inches. For the five crops in one season the transpiration is 6.66 acre inches, and the evaporation 17.34 acre inches. For the three crops produced by one irrigation of twelve inches, the transpiration would be 4.42 acre inches, and the evaporation and waste 7.58 acre inches. For the crops of wheat or barley using the 14 acre inches, the transpiration would be 1.77 acre inches, and the evaporation and waste 12.23 acre inches. For the crop of corn using 15 acre inches, the transpiration would be 2.65 acre inches, and the evaporation and waste 12.35 acre inches.

Further on, Major Powell repeats that the absolute duty of water is 18 acre inches, the possible duty 20 inches, and the practical duty 24 acre inches, and all water put upon the land in excess of this is an injurious duty.

He says again, by improved or scientific methods of cultivation, the crops may be doubled or multiplied five-fold, but under these circumstances the water must be increased proportionately, even to the extent of 60 or 100 acre inches or more.

How does this correspond with his repeated assertion that anything over 24 acre inches is an injurious

duty? His theory is that for a 2-ton crop the transpiration is 200 tons, or 1.77 acre inches.

If the crop is multiplied five fold, it is a ten ton crop, and the transpiration will be 1,000 tons, or 8.85 acre inches. He says nothing about any increase in the evaporation and waste, and after deducting his 6 acre inches for evaporation and waste, he leaves us with 85.15 acre inches to be disposed of in some way. Is it not an injurious duty? A goodly amount of water surely, to lose any account of, in this arid region. Some of my neighbors would think they had quite a reservoir if they had a pond containing ten acres of that depth.

SOURCES OF WATER SUPPLY.

Under the head of "The Sources of Water Supply," Mr. Powell treats of the rainfall and the water catch. He makes his assertions for the most part without assigning any reason for them, and without disclosing how he obtains his information, or arrives at his conclusions. He estimates the run-off at different depths of the rainfall, but gives us no idea of the proportional area of each, upon which his final estimate is made, except by his maps. He gives us no scale except the zones to work by, and as he says, they everywhere run into each other so that no such test could be made, and so far as we can see, it is a mere guess, perhaps as nearly correct as his 11½ tons for the acre inch of water.

He nowhere states what the mean average runoff, and the mean average flyoff is, on the area claimed to have 20 inches and less of rainfall. He arrives at the amount in some unexplained way, perhaps as little known to him, as the weight of the acre inch of water, or the 18 acre inches absolute duty of water, and then he slashes off 30 per cent. of it and blandly says that "space does not permit a discussion of the facts which lead to this conclusion." This minus quantity is the possible catch from which he again slashes another 30 per cent. and again "the reasons for this conclusion cannot be entered into for want of space." He tells us that he takes into account the runoff from the high mountainous country where the rainfall is consequently great, but he does not tell us what per cent., if any, he adds to the practical catch on that account.

He calls our attention to the fact that there is little or no runoff from the low level lands, but he fails to state (perhaps because he does not know it) that this low level land is the very land we will irrigate, and that the rainfall, of from 2 to 10 inches upon it, is of nearly, if not quite, as much benefit to our crops as it would be if it runoff, and was returned to the same, or other land. If we get 10 inches of rainfall on our crops, and then add thereto the full practical duty of water, are we not putting on 10 inches of injurious water?

So if the rainfall be but 2.4, or 6 inches, and we apply the full practical duty of water thereto, in addition, is it not just so much injurious water that had much better remain in our reservoir, or be used upon other lands?

Suppose we should get 6 inches of rainfall upon the 40 million acres which he estimates we can irrigate, it will be equal to 18 inches on $13\frac{1}{3}$ million acres. Why cannot we utilize this and thus extend the area to be irrigated? I know we practically get the benefit of the 7 inch rainfall in this valley, and why not in other places?

POSSIBLE AREA CAPABLE OF IRRIGATION.

And now I will consider the vital question with Major Powell—the area which can be irrigated. His estimate is 40 million acres. I have already shown that this may be increased to $53\frac{1}{3}$ million acres, leaving his conclusion about the possible and practical duty of water as he makes them, without eliminating his errors. Now, consider that the absolute duty of water according to his theory is 1.77 acre inches, instead of 18 acre inches, that the evaporation and waste is but 6 acre inches applying the water under economic conditions, as he claims, and we have the practical duty of 7.77 acre inches, instead of 24 acre inches, a little less than one-third after eliminating his errors, and we may irrigate three times $53\frac{1}{3}$ million acres, or 160 million acres. I will not now attempt to go beyond this, leaving his theory of the possible catch and the practical catch, with 60 per cent. slashed off from the actual runoff to stand for the present. But what about your practical application, says Major Powell. You have used 20.24 and even 29 acre inches, at least as much as I have claimed the practical duty to be. Yes, I admit that, but that is where the variables come in. Central Arizona is but a small portion of the arid region of the United States, and there is nothing else like it anywhere, and I do not know of any other place where the transpiration and evaporation should be as great as here. Consider the altitude, 1,100 feet, the distance from the sea coast, 300 miles, the extreme dryness of the atmosphere, and the depth of the soil, from 5 to 10 feet. Where else are these conditions all to be found? On what extent of the arid region can you produce five crops of alfalfa in one season? On what extent can

you raise more than two crops? On what extent can you produce a crop of wheat or barley and then a crop of corn in the same season? I have shown you that we can produce one crop of alfalfa with 5 acre inches of water; that we can produce three crops with 12 acre inches; that we can produce a crop of wheat or barley with 14 acre inches; and a crop of corn with 15 acre inches. With the exception of a small proportion of the arid region, two crops of alfalfa, one crop of wheat or barley, one crop of corn, and one crop of any other plant is the most that would be attempted, and hardly anywhere else would the demand for water be so great as here.

AVERAGE AMOUNT OF WATER REQUIRED.

The average here would be between 12.14 and 15 acre inches. These added together make 41, and $\frac{1}{3}$ of 41 is 13.66 acre inches, and we could irrigate 110 million acres, if the whole arid region required as much as we do. I am led to believe that if Major Powell had not fallen into the grave errors, to which I have called attention, he would have found that the amount of land possible to irrigate in the arid region would not fall much, if any, short of the 160 million acres. It is intended that we, the people, shall be benefited by the expenditure of the large amount of money annually devoted to paying the expenses of that particular branch of our political economy that is directed by the genius of Major Powell, and it may be well for us to take heed and abide by his statistics and theories. But when we detect him in committing errors, even though it may be only the trifle, 1,830 tons in the weight of, or $16\frac{1}{4}$ acre inches in the depth of the absolute duty of water for one acre, is it not natural that we should have some grave doubts about the correctness of his statement in general?

I have considered the position he occupies, and the high reputation he bears in his profession, and I have tried to reconcile his statements and theories, and the result is here given. If any person can throw any more light on the subject, I shall be glad, for I am in search of light on the subject of irrigation, and the amount of water that various plants will transpire while growing, and how much will evaporate in the same time from different soils under different climatic conditions.

THE FUTURE OF THE AMERICAN SUGAR INDUSTRY.

BY W. C. FITZSIMMONS.

APPROXIMATELY 280,000 tons of sugar were produced in the United States last year, of which about 22,000 tons came from beets and the remainder from cane. Nearly all the cane sugar was produced in Louisiana, and the greater part of the beet sugar was produced in California. There are three beet sugar factories in the latter State with a prospect that another will be erected during the present year. The largest of these establishments is at Watsonville, in Santa Cruz county, and is at present the largest in the United States. During the past season the out-turn from this factory amounted to 7,798½ tons of sugar, besides a large quantity of syrup. To produce this quantity of sugar and syrup 65,396½ tons of beets were used, which were grown in the neighborhood and sold at the factory for a uniform price of \$5 per ton. The average yield of beets per acre was rather over twelve tons, and the total cost of producing the crop not far from \$20 per acre. So well pleased are the farmers with the last season's outcome that a greatly increased acreage of beets has been contracted for the coming season, and will probably exceed ten thousand acres. The factory is undergoing enlargement, and at the opening of the campaign in October next it will have the capacity to manufacture a thousand tons of beets per day.

THE CHINO FACTORY.

At Chino, in Southern California, near Los Angeles, is the sugar factory of the Oxnard Company, which has been in operation only three seasons. The soil and climate of that region are found to be eminently fitted for the production of a large yield of beet roots rich in saccharine matter. The establishment of this great enterprise at Chino was due to Mr. Richard Gird, owner of the fertile Chino ranch, comprising some 60,000 acres. Mr. Gird gave a liberal subsidy in land whereon to erect the buildings, and made other valuable concessions in order to secure the location of the factory. The enterprise proved a success from the first, although many obstacles had to be overcome both by the beet growers and by those who utilized their product. The output of the factory has greatly increased each year, as well as the yield per acre of beets planted, showing the most encouraging progress. Nothing could better illustrate the confidence of the neighboring farmers in the profitable and permanent nature of the business than the fact that many of those who had previously rented land of Mr. Gird upon which to grow beets, recently purchased the land at auction, paying as high as \$150 per acre. The

Chino factory will also be enlarged so that its capacity will be equal to the proper handling of at least a thousand tons of beets daily at the opening of the next campaign.

THE FACTORY AT ALVARADO.

The third and smallest sugar factory in California is that at Alvarado, near San Francisco. This is the oldest beet sugar establishment in the United States, and is a highly successful concern, though less extensive in its operations than the other two in the State. During the campaign of 1893, the Alvarado factory handled about 21,000 tons of beets and produced 4,500,000 pounds of sugar. It is expected to handle an increased acreage of roots during the present year, and under favorable conditions this plant will doubtless be enlarged also.

OTHER BEET SUGAR FACTORIES.

Two beet sugaries are to be found in Nebraska—one at Norfolk and one at Grand Island. These establishments hold similar relations with the farmers of Nebraska to those existing in California. It is a generally accepted fact, however, that a somewhat greater percentage of saccharine matter is developed in the Californian beets than in those grown in Nebraska. Nevertheless the business of beet root production in Nebraska appears so well established that other factories are projected. It has lately been reported that certain foreign capitalists were negotiating for the erection of an immense sugar plant in that State to cost \$1,500,000.

THE UTAH FACTORY.

Still another beet sugar factory exists in the United States, and is to be found in Utah. Its capacity is not so great as that of some of the others mentioned, but the promise of the industry in that Territory now affords the greatest encouragement to the early enlargement of the plant and a corresponding increase in the acreage of beets handled. There is a large area of land in Utah, as well as in most of the arid regions, peculiarly adapted to the production of the sugar beet. Analysis of beets produced in Utah, Nevada, Arizona, eastern Washington and Oregon have shown a high percentage of sucrose, and so far as soil and climate may contribute to the success of any form of culture, the production of the sugar beet should be found a highly profitable undertaking in very many sections of the arid belt.

THE WORLD'S SUGAR.

The total production of sugar of all kinds in the world has reached about six million tons annually,



THE FUTURE SUGAR FIELDS OF AMERICA, WHERE BEETS WILL BE PRODUCED BY IRRIGATION.

about equally divided between the cane and the beet. Germany produces most beet sugar, under the stimulating influence of a bounty which has served for many years to expand the industry to very large proportions. France, Russia and Italy are also large producers of sugar from beet roots, but nowhere else is seen so great expansion of the industry due to a government bounty as in Germany. At the present moment, however, there exists in the United States an analogous condition in the two-cent bounty created by the McKinley tariff act. This bounty applies not only to sugar produced from beets, but also to that produced from canes and from the sap of the maple tree. At this writing the House of Representatives has passed the Wilson bill, providing for a gradual abolition of the sugar bounty, but whether such

action will be finally sustained by the Senate is not yet known. It is probable, however, that by the time this issue of *THE AGE* reaches the public the matter will have been settled, either by the adoption or rejection of the measure on the part of the Senate.

At present, therefore, we shall be concerned with the economic consideration of the question rather than with its political aspects.

AN IMMENSE FIELD FOR AMERICAN INDUSTRY.

No other avenue at present opens so wide a field for American capital and labor as that of producing our home supplies of sugar. The United States as a people consume about one-third of all the sugar produced in the world, and the annual increase in consumption is held to be about five per cent. The present yearly consumption is, in round numbers

about two million tons of sugar. For the fiscal year ending with June last, sugar was imported to the amount of 3,733,040,266 pounds, or 1,866,520 tons, besides 15,490,679 gallons of molasses. These importations cost the stupendous sum of \$116,947,430. It will thus be seen that besides the home product of all kinds of sugar, our imports amount to about sixty pounds for each of our 65,000,000 inhabitants. Thus no other field for American enterprise of a creative nature in our own country and to supply a home need compares with that of sugar production, provided the conditions be favorable for its full development. That such conditions now exist under the bounty law there is no question; and that with present conditions remaining constant for a period of years the production of sugar in this country would be immensely extended is equally sure. What effect pending legislation will have upon this important question cannot now be told; but supposing that it will permit the expansion of sugar manufacture to the point of supplying the entire demand, the following data may afford the reader some conception of the gigantic nature of the consequent development and upbuilding of the country.

ROOM FOR MORE FACTORIES.

To produce from beets grown in the United States the amount of sugar imported from other countries for the last fiscal year would require 240 factories of equal capacity with that at Watsonville, California, the largest on the continent. At the ratio of 8.4 tons of beets to one of sugar, as at the Watsonville establishment, the beets required would amount to 156,787,680 tons, and would occupy about 1,300,000 acres, producing 12 tons each per year. At a labor cost of \$20 per acre annually in the production of this crop, there would be disbursed on this account each year over \$260,000,000 for farm labor alone, to say nothing of the labor and expense of the manufacture itself. To erect the factories needed for the work would require an outlay of a half-million each, or say \$120,000,000 for the various sugar plants throughout the country. And this would not be disbursed in cities, nor invested in corner lots or brick blocks in cities or towns, but would all be expended in rural districts for the practical upbuilding of farming communities. While it is true that the two-cent bounty on this enormous production of sugar would amount to \$74,660,000 annually, yet it would all be expended in our own country and among our own people. The per capita tax for the payment of sugar boun-

ties would amount to about \$1.15; while the amount per capita now sent out of the country annually to purchase foreign sugar is \$1.80. In addition to the benefits previously mentioned, a number of collateral industries would be developed about each center of sugar manufacture, resulting in a great number of prosperous and thickly populated communities, not possible except for such favorable conditions. From the beet pulp at the Chino factory Mr. Gird has fattened some 1,500 head of cattle, which add greatly to the profits of the enterprise. All such collateral advantages would be shared to some extent by the communities in which the factories should be located, and the number of factories named would furnish material for the fattening of 360,000,000 pounds of beef annually.

Thus while actual experience in the communities themselves in which sugar factories are located demonstrates the correctness of the figures above made relative to the paramount advantages to be derived, it remains to be seen whether the sugar interest in this country absolutely requires the stimulus of a government subsidy to insure its timely and permanent development.

LOCAL BENEFITS.

As illustrating to some extent the advantages to flow from the establishment of beet sugar factories, it may be mentioned that three years ago Chino, California, was an insignificant hamlet comprising but a few families, with only the average conditions of the small country village. Through the stimulus given by the beet industry the town has grown to considerable importance, has several hundred voters, as well as a goodly number of school children, who will attend school in a \$10,000 house the present year. An able, clean and bright weekly paper is published at Chino, the surrounding country is thickly populated; and altogether there has been created in the short period of three years a prosperous and progressive community, centering therein nearly all of the most modern accessories of the highest civilization and culture.

All of the advantages which have come to Chino by reason of the beet root industry may come to any and all of the hundreds of centers of sugar making, whether from canes or beet roots, which would spring up under such economic conditions as would permit the people of this country to produce the raw materials and then manufacture their own supplies of sugar and syrup.

TALKS WITH PRACTICAL IRRIGATORS.

POTATOES BY IRRIGATION.

BY J. W. GREGORY.

THE ground, if to be irrigated, should be as smooth piece, and having sufficient slope to make the water run freely between the rows. It should be plowed eight inches deep, or more, and then harrowed and dragged or rolled until the soil is firm throughout and thoroughly pulverized on the surface. Now lay off your ground in rows some three and one-half feet apart, with a corn-marker or a small shovel which will make a shallow furrow, the rows running the same way the ground slopes, if it is not too steep. A slope of seven to ten feet per mile gives good results. Drop the cut potatoes, one piece at a time, one foot apart (or two pieces twenty inches to two feet apart), in the mark or furrow, and cover by throwing up from each side a good slice with a two-horse stirring plow. This will cover the potatoes to a good depth and leave the potatoes in ridges for irrigation. The water can now be run between the rows and must not be allowed to rise up over the ridges nor to wet the vines. It should be applied as sparingly as possible, only so the plants are kept growing evenly, and the last and most abundant irrigation should be applied when the plants are in bloom. The whole secret of potato-growing is to keep the plants going at an even pace—not by fits and starts—giving them water enough to accomplish this, yet not so much as to make them “scabby,” which too much water will do. The ground must be kept clear of weeds and it must be stirred soon enough after each irrigation to keep the whole surface of the ground—between the rows as well as on top—mellow and fine.

The foregoing directions as to the method of laying off the ground presuppose a dry spring and dry ground which will have to be irrigated from the first. If, however, the ground is moist and in good condition to begin with, or there is water enough on hand to flood the ground the first thing, and especially if there is to be a large tract planted, so that the matter of cultivation cuts much of a figure, it is well to have the ground well wet before plowing, taking care to keep it harrowed down fine as fast as plowed, so as to avoid drying out or forming clods; then have the furrows to plant in deep enough so that when the potatoes are covered the ground may be dragged smooth, or nearly so. This will make the surface so fine that the potatoes will need no more water until they have come up and been harrowed at least once and then

ridged up. In this way no irrigation would probably be needed until the potatoes were in bloom. At any rate, they should not be irrigated so long as they get along well. If rains should come and set them to growing at a thrifty rate, then the grower should watch and keep up that rate of growth, so that the potatoes may be smooth; not allow the growth to be checked, and then, by putting on water, start out a new growth, which will make the potatoes knobby.

SMUT IN WHEAT AND OATS.

It is well understood that grain smuts are parasitic plants of a fungus character, and that they reproduce themselves in uncounted millions by means of spores. For many years it has been known to scientists, and also to some wheat growers, that the same fungicides employed to destroy fungus growths on other plants may be used with advantage upon grain. It may be here said that one of the recognized advantages of our various experiment stations is that through their agency we are often shown either new processes or simplifications of old ones resulting greatly to the benefit of agriculture. Relative to the treatment for smut by the copper sulphate process bulletin No. 32 of the Indiana experiment station gives minute directions for preparing seed which in a general way may be said to consist in soaking it for a short time in a solution of blue vitriol. But farmers interested in this subject (and who of them is not?) should send for this bulletin and retain it for reference. In some States it is estimated that fully twenty per cent. of the crop of oats is annually lost through attacks of the smut fungus. By proper treatment of the seed before sowing, and at slight expense, this great loss can be prevented, and the same is true to a great extent of the wheat crop. Some seasons the corn crop also is greatly lessened in yield of grain by the prevalence of smut, and the value of the fodder is also much diminished, besides being dangerous to the health of animals consuming it even in small quantities. By close attention to the bulletins of the experiment stations farmers may be entirely certain to profit in the course of the year. The cost to the receiver is little or nothing except a postage stamp, and every man who tills the soil should have all of the bulletins issued from the station in his own State, and as many more as he can conveniently get. In these years, next to first-class journals treating broadly all interests relating to agriculture, which every farmer should diligently read, the bulletins of

the experiment stations will be found of great value. There is a notion abroad among some old-fashioned farmers—some irrigating farmers perhaps also—that they can learn little or nothing about their business from books and papers. This is a serious error. No man in this day can successfully conduct the business of farming in competition with his fellows, who is not a close student of methods and suggestions given in the foremost journals devoted to his interests. It is a costly error for a farmer to indulge that he “knows all about farming.” No man knows that; but *THE AGE* pledges itself to be helpful to the whole body of farmers, and especially to irrigators.

NEW VARIETIES OF POTATOES.

Bulletin No. 30, of the Oregon Experiment Station is valuable for the information given regarding new varieties of potatoes. Last year experiments were made with 153 varieties at the Oregon Station, 88 being grown in plats sufficiently large to warrant calculations regarding the yield per acre. Among the most promising varieties, as shown by these experiments, some of which were continued for two years, are the following: Dublin Chief, James Vich, Burling, White Lion, Thorburn's Late Rose, Dakota Red, Tilden, Early Sunrise, Rochester Favorite, Silver Skin, Salt Lake Rose and Van Orman's Superb.

Of these varieties, Thorburn's Late Rose, Early Sunrise, Silver Skin and Dakota Red are highly recommended. Of all the varieties tested, the Salt Lake Rose gave the highest yield, 279½ bushels per acre, while Thorburn's Late Rose yielded 215½ bushels per acre. Although grown on clover sod no fertilizers were used, and the results obtained are regarded as quite satisfactory under the circumstances.

EXPERIMENTAL FARMING IN UTAH.

BY PRES. J. W. SANBORN.

II

Varying amounts of seed wheat and oats have been sown on another section and agree in their results with the common views held by farmers in relation to amount of seed required. The same may be said in a series of plats on harvesting. The results make it clear that wheat until it is dried through and hard to the center continues growth. An extensive series complexly arranged crop rotations, 2, 4 and 6 years series show that rotation is much more successful than where a crop follows itself. These data we regard as of very great importance. Other trials in forage crops and method of handling crops are in progress. Twelve acres of the farm are given over to horticultural products, vegetables and small and large fruits, under charge of Prof. E. S. Richman. The work there is largely given to variety tests and

with the larger fruits and forest trees we make only notes and progress. Sufficient to say that fruits flourish here of fine quality and color.

In the barn throughout the entire year extensive experiments are constantly in progress in animal nutrition, involving the feeding of cattle, sheep, horses and hogs. A review of these trials would make an extensive demand upon your columns. So little research is given to feeding horses that I will at this time merely note the results of two or three experiments in this direction. It was found that blanketing horses in a stable of moderate temperature was an unprofitable process. It was found that watering horses after feeding was an economical method, not because digestion was increased, or the percentage of food digested was increased, but because when watered before eating the appetite is a little keener and the horses ate a little more, thereby leaving a greater excess above maintenance for use either in flesh or work. The better method probably is to water both before and after feeding. It was found that cutting clover increased its efficiency to a decided degree. Another experiment in feeding hay and grain mixed to horses as against hay and grain fed unmixed showed no advantage in mixing the hay and grain. Little advantage or no advantage was found in grinding grain for horses. Still another trial was made with carbonaceous rations against nitrogenous. The belief is a prevalent one that corn meal is a heating food and does not contain protein enough for the horse engaged as he is in muscular work. Corn and timothy and carbonaceous ration was fed against lucerne and clover, oats and wheat to the advantage of the latter ration. The advantage however, is believed to be due largely to the fact that it is a more palatable ration, because a more varied ration, and partly to the fact that it is fed in the summer season. This trial is now under progress again in a somewhat modified form during the colder season of the year. An article of this kind cannot discuss the reason for entering into the experiments named. They are all based upon some philosophic reason. Farmers are chiefly interested in the results.

The station has connected with it an hydraulic engineer, Prof. S. Fortier, who devoted the summer season investigating the irrigation problems of the territory, and there is now in press a partial report of his investigations that will be of very much interest to the irrigating world. With the station also is associated a biologist, whose time is devoted to plant and animal diseases, Dr. F. W. Brewer. Dr. Brewer has been on leave of absence, as the head of the division of hygiene and sanitation at the World's Fair, and is about to commence active operations with us. The college recently added a specialist in dairying, and much work will be done in this direction. The man

in charge is Mr. F. B. Linfield, formerly of the traveling dairy school of the Province of Ontario. This work will be made a prominent feature.

The chemical laboratory has had at its head Prof. W. P. Cutter, who resigned a few months ago. His assistant, Mr. R. W. Erwin, a senior in the college, is now in charge. His work has been recently narrowed to include mostly ordinary routine analyses that accompany the farm operation. One work of some interest to irrigators of the arid region was a test of the waters of several rivers of Utah. These rivers show a large amount of lime and bring to the soil more than their essential supply, but they are exceedingly deficient in potash-phosphoric acid, a mere trace of the latter being found, and make it apparent that the irrigating waters that proceed from the Wasatch range are unequal to maintain the fertility of the soil unless supplemented by manures of some kind.

The station is now nearly four years old, publishes one bulletin per month, and an annual report of 200 to 300 pages; and is, as you will observe, engaged in an extensive series of experiments covering the great fields of interest to our western farmers. In addition to the irrigation experiments mentioned, others are associated with the horticultural department, and the station will make more prominent in the future its irrigation researches, now embracing those of the farm, the horticultural department, and of Prof. Fortier as hydraulic engineer of the station, who will investigate the irrigation systems of the territory and do some practical work in the interest of the irrigators of Utah. Most of our work, as you will observe, is along new lines of investigation in irrigation problems.

A LARGE ITEM OF WASTE.

One fruitful source of waste on the farm is the unscientific treatment of farmyard manures. It is estimated that a reasonable value of the manures produced upon the farms of the State of New York is a hundred million dollars, nearly one-half of which is wasted through ignorance or neglect of the proper methods of handling it. Professor Voelker of the Royal Agricultural College of Gloucester, England, who has given much time and labor to the subject advises that barnyard manure be kept composted and under shelter. It should also be kept moist during the period of fermentation, in order to prevent the escape of nitrogen. Professor Voelker also assures us that the urine of animals is the most valuable part of farmyard manure, and should be scrupulously preserved with the other more solid ingredients of the compost heap. It is well known, too, that gypsum, or land plaster, applied plentifully to the manure heap will prevent the loss of nitrogen and add materially to the value of farmyard manure.

Poultry should constitute a source of revenue on every farmstead and orchard. Especially may the orchard derive great advantage from keeping poultry, aside from the pleasure and profit coming from having a good supply of eggs and "spring chickens" for family use. Poultry should be allowed to range freely in the orchard, and indeed should often be compelled to do so. Many small orchards are kept comparatively free from insect pests by having a flock of poultry ranging about under the trees. While nearly all breeds of domestic fowls are valuable, some are worth much more than others. Some recent investigations of the value of different crosses among various breeds of poultry at the Rhode Island Experiment Station led to the recommendation of certain crosses as follows:

"The various crosses, both alive and dressed, were exhibited at the Rhode Island poultry exhibition in December. A description of the carcasses of each cross was given, together with data as to the live weight at time of killing and the loss on dressing. The judges pronounced the cross of Indian Game on Light Brahma the best specimen of dressed poultry, followed by the crosses of White Wyandotte on Indian Game, White Wyandotte on Light Brahma, Indian Game on Golden Wyandotte, and Dorking on Dark Brahma. The judgment was made in accordance with the popular demand for yellow poultry."

IMPORTING POTATOES AND BEANS.

For the calendar year 1893, there were imported into the United States 4,061,359 bushels of potatoes, at an invoice valuation at ports of export of \$1,998,708. The amount of beans imported during the same period was 1,584,312 bushels, valued at \$1,525,154. To pay for these, wheat was exported at a farm value of less than 54 cents per bushel. It would seem as though such object lessons as these would soon teach the American farmer the supreme folly of continuing on year after year, in the same unprofitable rut of raising wheat at a very low price in order to purchase his potatoes and beans in foreign countries at high prices. It requires a little more labor to produce a crop of potatoes or beans to be sure than a crop of wheat, acre for acre; but when it is remembered that a good home market nearly always awaits the former while the latter must be sold abroad, or at least that the price is fixed abroad, it must be clear that some changes are needed in our system of cropping.

There will be an irrigation convention held in Gering about June 19th and 20th. Many prominent irrigation men are expected to attend. Farmers in this valley are putting in considerable alfalfa this spring; about 2,000 acres will be planted.

SIMPLE EARTHEN DAMS.

BY SAMUEL FORTIER.

II

In some instances the water is pumped by an engine through a system of piping and the water is applied by lines of hose with nozzles attached. Assuming that water can be brought by gravity, perhaps the cheapest and most effective method is as follows:

Allow water to run into the trench named above until full, then begin to form the base of the embankments. As the contents of the scrapers, carts or wagons are dumped on the fill, have them thoroughly sprinkled by an ordinary street sprinkling wagon. If such is not available, a good substitute may be made out of a large barrel or redwood plank box with a piece of perforated pipe for a sprinkler, controlled by a hinged flap valve faced with leather.

If the material is still too dry to pack well, it is advisable to sprinkle or wet in some way the material before taken from the pit. As the fill rises more water is turned into the trench so that the whole base presents an appearance of two low, wide embankments, with a canal full of water between. The better way, theoretically, would be to allow both halves of the base to slope up stream, but it is somewhat difficult to do this in practice and the plan followed by the writer has been to allow both slides to slope towards the canal in the center. By so doing the material is readily crowded into the water and the outer edges being highest, the whole top can be flooded if necessary, when the teams are not working. The sketch showing cross section in partially completed embankment will illustrate the method.

In one reservoir built under the superintendence of the writer there was a shrinkage in material at the time of building of twenty-seven per cent. In other words, every cubic yard excavated after being moistened and packed did not make quite three-fourths of a yard in the fill.

By building in water in the center one secures practically the same results as with a core of puddled clay, concrete or masonry, without the serious disadvantage of a joint on each side of such a core, which often proves fatal to the structure. By the other way there are no distinct joints, since the water in the canal percolates quite a distance on each side, and then these half embankments are watered by a sprinkler and packed by the passage of the teams into a mass nearly as compact as that done under water.

Another suggestion to those inexperienced in such work may be made, in relation to the sorting of the materials. In nearly every case in practice the contents of the bank or pit differ, running from fine to

coarse and from porous to impervious, and successful practice requires the placing of that which is the best adapted to retain water next to the edge of the water, or on the inner half, while the rocks, larger gravel and heavy substances in general are ranged from the outside towards the center on the outer half. In contract work it is well to have a man where excavation is made who shall direct where each team shall unload, thus securing a staple and at the same time an impervious bank. In distributing reservoirs for city systems the slopes are made comparatively steep, say from $1\frac{1}{2}$ horizontal to 1 vertical, up to $2\frac{1}{2}$ to 1, since the outer slope is usually seeded down to grass to prevent wash, while the inner slope is paved with brick, cement concrete, asphalt or stone. In storing water for irrigation it is advisable to make the slopes, particularly the inner one, more flat and to protect it where it is liable to wash by riprapping with rock or slag, or lining with lumber.

Notwithstanding all these precautions, if there is not sufficient space for the water, in great floods, to escape other than over the top of the dam, a wash-out is inevitable. In many proposed sites a narrow rocky ridge can be blasted off down to a level of the surface of the water in the reservoir when full. In other sites an earthen bank may be excavated down to a similar level, and the surplus water wasted through a short, wide canal made for that purpose, having as steppe a grade as the nature of the earth will permit. If the material is not suitable a flume of some kind will answer all requirements, and in deciding upon its area it is well to figure up the total maximum flow of surplus water which is ever likely to pass through this flume, and then to make it as large again as such a volume requires.

SOMETHING ABOUT ALKALI.

Some farmers in alkali districts believe that the alkali observed in their soils, and which often prevents the growth of crops, is the result of an excess of potash in the soil. This, unfortunately, is not the case. Were it so such spots would become among the most valuable on the farm, for potash is of absolute necessity in the growth of nearly all plants produced upon the farm. It is an excess of the carbonate of soda in the soil which shows as "alkali spots," and which are so great a drawback to farming in many parts of the arid belt. Very little soda is used by plants ordinarily produced upon the farm, hence its presence in excess in any soil is detrimental. It may sometimes be leached away by irrigation and drainage; and by the free use of gypsum on such lands the effects of the alkali may be neutralized to a very great extent. It is alleged by experienced fruit growers that pears may be successfully grown upon alkali land where other fruits will not grow.

SOMETHING NEW IN IRRIGATION.

A novel device for irrigating lands along water courses has lately been put in use on the Sacramento river in California. A company has organized, or offered to organize, a pumping plant, capable of supplying a large flow of water, the whole being placed on a barge which is floated along the stream and operated wherever desired. It is proposed to supply farmers and orchardists near the river with all the water desired at a cost of only two cents per thousand gallons. At such cost it certainly behooves the farmer or fruit grower who can use the water so offered to do so to the full extent needed by the crops he seeks to produce. At this writing it is not known to what extent this system of littoral irrigation may be developed, but should it prove successful along the Sacramento, there is no good reason why it may not be put in practice elsewhere, pending the development of other and perhaps better systems of irrigation on lines well tried and approved by long and successful experience.

SUGAR BEETS IN WYOMING.

Prof. E. E. Slossen, in bulletin No. 17 of the Wyoming Experiment Station at Laramie, gives an interesting account of the experiments in the culture of sugar beets carried on at the six experiment farms during the past year.

It is said that experience in various seasons has shown that beets unusually rich in sugar can be grown by irrigation in almost all parts of Wyoming, and that in their crop report the sucrose content of the beets has been above 12 per cent. The officers of the station claim to have thoroughly demonstrated the desirability of Wyoming for sugar beet production, and that it remains now for the people of the State to develop the sugar industry.

LOSS OF WATER BY SEEPAGE.

The loss by seepage from ditches is considerable, and with the increased value of water it is probable that many will find it profitable to so construct their ditches as to save loss from this source. In several places in the State farmers have recently made their laterals of sewer pipe, saving loss from seepage and the annoyance of trouble with neighbors. The State agricultural college at Fort Collins is constructing such a line for the purpose of collecting seepage water, and in addition for carrying the supply of water which comes from one ditch. The pipe line is made of 15-inch sewer pipe for the greater part of its length, carried underground below the plow and frost. The gathering galleries are of smaller pipe, laid without cement. The length of the main pipe is about 4,000 feet. It is expected to collect some

water by this means for use late in the season when the ditch furnishes no water. The work is being carried on under the direction of the professor of engineering, with Ray Walter, one of the graduates of the engineering course, as constructing engineer.

THE CREAMERY INDUSTRY.

A hopeful sign of increasing prosperity in the North Pacific States is the awakened interest shown, especially in Washington and Oregon, in the establishment of creameries. The abundant pasturage procurable over so wide an area in the two States named has long been a standing protest against importing from the East or from California so large a percentage of the dairy products consumed. It is gratifying to observe the increasing interest taken in the dairy in the sound States, and the prospect now is that but a short time will elapse before those States will be large exporters of dairy products rather than importers. To a considerable extent the same may be said of poultry. It is found much easier, cheaper and in every way more satisfactory to produce a home supply of poultry and eggs than to procure them by selling wheat at the rate of a bushel for two dozen eggs. To produce a home supply of food is not only a privilege of the farmer, but it is his first duty to himself, his family and the community in which he lives.

OVER-PRODUCING WHEAT.

Gradually, and in some sections of the country, the wheat farmers are coming to see that over-production is one of the great evils with which they are contending. It is reported from Minnesota, for example, that the acreage of spring wheat sown has been considerably diminished the present season, in some districts amounting to a decrease on the acreage of perhaps 30 per cent. This is well, but if the farmers of Minnesota alone curtail their output, little good will follow. It is also reported from Kansas that some farmers' clubs in the western counties, impressed with the over-production idea, have been plowing under considerable acreages of fairly good wheat. This is alleged to have been done under the impression that it would raise the price of wheat. While such action on so small a scale reminds one of the fable of the bull and the gnat, and can have no possible impression upon the wheat market, yet the principle of curtailment of output is correct. But concert of action along this line must be secured before tangible results can be reached.

The Enterprise Canal people are making improvements on their canal by widening out the canal from 16 feet to 24 feet, and putting in a new head-gate. Approximate cost of improvements, \$6,000. T. D. Dietche is superintending the work.

HORTICULTURE BY IRRIGATION.

WHAT, WHEN, AND HOW TO SPRAY.

All well informed orchardists of experience recognize the prime necessity of properly spraying their trees. In no part of the United States are the orchards so free from disease and insect enemies as to relieve the fruit grower from the labor and expense of waging an annual warfare against his tireless foes. It is alleged that in spite of all the efforts directed to the destruction of noxious insects, the annual loss to the farmer and fruit grower from this cause alone amounts to hundreds of millions of dollars. In view therefore, of the transcendent importance of a correct knowledge of the subject of proper and timely spray-

ing of orchards, it is hoped that the subject as herein presented may meet with the approbation of orchardists generally. For much of the valuable information here given we are indebted to the careful and prolonged researches of Professor Bailey, of the Experiment Station at Cornell University, New York. The information conveyed by the table, and formula following may be easily worth to a single orchardist a hundred times the yearly cost of THE IRRIGATION AGE, and this number should be carefully preserved for future use, for the orchardist will certainly have frequent need to draw upon these pages for guidance in his work.

PLANT.	1st Application.	2d Application.	3d Application.	4th Application.
APPLE..... (Scab, codlin moth, bud moth.)	When the buds are swelling, copper sulphate solution.	Just before blossoms open, Bordeaux. For bud moth. Arsenites when the leaf buds open.	When blossoms have fallen Bordeaux and Arsenites.	8-12 days later, Bordeaux and arsenites.
BEAN..... (Anthracnose.)	When third leaf expands, Bordeaux.	Ten days later, Bordeaux.	Fourteen days later, Bordeaux.	Fourteen days later, Bordeaux.
CABBAGE.... (Worms, aphids.)	When worms or aphids first seen, kerosene emulsion.	7-10 days later, if not heading, renew the emulsion.	7-10 days later, if heading, hot water, 130 degrees F.	Repeat third in 10-14 days if necessary.
CHERRY..... (Rot, aphids, slug.) Too late for 1st application.	As buds are breaking, Bordeaux; when aphids appear, kerosene emulsion.	When fruits have set, Bordeaux. If slugs appear, dust leaves with air slk'd lime. Hellebore.	10-14 days, if rot appears, Bordeaux.	10-14 days later, Ammoniacal copper carbonate.
CURRENT..... (Mildew, worms.)	At the first sight of worms, Arsenites.	Ten days later, hellebore. If leaves' mildew, Bordeaux.	If worms persist, Hellebore.	
GOOSEBERRY..... (Mildew.)	When leaves expand, Bordeaux.	10-14 days later, Bordeaux.	10-14 days later, ammoniacal copper carbonate.	10-14 days later repeat third.
GRAPE..... (Fungus diseases.)	In spring when the buds swell, copper sulphate solution.	When leaves are 1½ inches in diameter, Bordeaux.	When the flowers are open, Bordeaux.	10-14 days later, Bordeaux.
NURSERY STOCK..... (Fungus diseases.)	When first leaves appear, Bordeaux.	10-14 days later repeat first.	10-14 days repeat first.	10-14 days repeat first.
PEACH, NECTARINE..... (Rot, mildew.) Too late for 1st application.	Before buds swell, copper sulphate solution.	Before flowers open, Bordeaux.	When fruit is nearly grown, Bordeaux.	5-7 days later, ammoniacal copper carbonate.
PEAR..... (Leaf blight, scab, psylla, codlin moth.)	As buds are swelling, copper sulphate solution.	Just before blossoms open, Bordeaux. Kerosene emulsion when leaves open, for psylla.	After blossoms have fallen, Bordeaux and Arsenites; kerosene emulsion if necessary.	8-12 days later repeat third.
PLUM..... (Fungus diseases, curculio.)	As buds are swelling, copper sulphate solution.	When blossoms have fallen, Bordeaux. Begin to jar trees for curculio.	10-14 days later, Bordeaux.	10-20 days later, Bordeaux.
RASPBERRY, } BLACKBERRY, } DEWBERRY, } (Anthracnose.)	Before the buds are breaking, copper sulphate solution.	During summer, if rust appears on the trees, Bordeaux.	Orange or red rust is treated best by destroying the plants	
STRAWBERRY..... (Rust.)	As first fruits are setting, Bordeaux.	As first fruits are ripening, ammoniacal copper carbonate.	When last fruits are harvested, Bordeaux.	Repeat third if foliage rust.
TOMATO..... (Rot, blight.)	At first appearance of blight or rot, Bordeaux.	Repeat first if the diseases are not checked.	Repeat first when necessary.	

Following will be found formula for preparing most of the spraying compounds recommended in the foregoing table, and the list, including the lime, sulphur and salt mixture previously given in these columns, should be scrupulously preserved for reference.

BORDEAUX MIXTURE—Copper sulphate, 6 pounds; quicklime, 4 pounds; water, 40 gallons. Dissolve the copper sulphate by putting in a bag of coarse cloth and hanging this in a vessel holding at least four gallons, so that it is just covered by the water. Use an earthen or wooden vessel. Slake the lime in an equal amount of water. Then mix the two and add enough water to make 40 gallons. It is then ready for immediate use. For rots, molds, mildews, and all fungus diseases.

AMMONIACAL COPPER CARBONATE—Copper carbonate, 1 ounce; ammonia, enough to dissolve the copper; water, 9 gallons. The copper carbonate is best dissolved in large bottles, where it will keep indefinitely, and it should be diluted with water as required. For same purposes as Bordeaux.

COPPER SULPHATE SOLUTION—Copper sulphate, 1 pound; water, 15 gallons. Dissolve the copper sulphate in water when it is ready for use. This should never be applied to foliage, but must be used before the buds break. For peaches and nectarines, use 25 gallons of water. For fungus diseases.

PARIS GREEN—Paris green, 1 pound; water, 250 gallons. If this mixture is to be used upon peach trees, 1 pound quicklime should be added. Repeated applications will injure most foliage unless lime is added. Paris green and Bordeaux can be used together with perfect safety. The action of neither is weakened, and the Paris green loses all caustic properties. For insects which chew.

LONDON PURPLE—This is used in the same proportion as Paris green, but as it is more caustic, it should be applied with the lime or with the Bordeaux mixture. Do not use it on peach or plum. For insects which chew.

HELLEBORE—Fresh white hellebore, 1 ounce; water, 3 gallons. Apply when mixed. For insects which chew.

KEROSENE EMULSION—Hard soap, $\frac{1}{2}$ pound; boiling water, 1 gallon; kerosene, 2 gallons. Dissolve the soap in the water, add the kerosene, and churn with a pump for five to ten minutes. Dilute ten to fifteen times before using. For insects which suck, cabbage worms and all insects which have soft bodies. For aphides or plant lice use kerosene emulsion on all plants. Black knots on plums or cherries should be cut out and burned as soon as discovered.

While in some cases it will be found too late to use the remedies prescribed this season, yet the table should be put aside to be referred to at some later period this year or early next summer. It will surely be needed. It might at times be found necessary to make one or two more applications of the remedies prescribed, but it will generally result that not more than four sprayings will be required. A number of appliances are made for administering the remedies, and spray pumps of proved efficiency are not hard to find at reasonable prices. The number of trees to be treated would generally dictate the character and capacity of the spraying appliance demanded. For small orchards hand pumps carried by the operator will no doubt be found effective, while for large areas the pumps and spray materials should be carried on wagons. In such cases it is sometimes found economical to have sufficient apparatus to spray two or more rows of trees at once as the vehicle is moved along by the team at a brisk walk. In the preparation of the various compounds great care should be taken to follow closely the directions given, for the formulæ have been arrived at by careful experiments and are as nearly what they should be as is possible with present

experience. If weaker solutions are used, spray oftener. It may not be out of place to say in this connection that certain demagogic efforts have been made to cut off or abolish the work of the Experiment Stations. Every farmer and fruit grower should demand that they be maintained. They are of the utmost value, and should be liberally and loyally sustained.

IRRIGATING HILLSIDES.

In irrigating hillside orchards, great care should be exercised lest much of the best soil, as well as the manures applied, be washed away. With slopes at all pronounced, great care should be taken to draw the irrigating furrows across the slopes in such direction as may insure a proper flow without the danger of washing. No definite rule can be given for this, but a little experience and training of the eye to judge of the proper declivity to insure a safe flow of water, will soon tell the careful cultivator in what direction to run his irrigating furrows, if the water be applied in that manner.

It is always better, at least in most soils found in the arid regions, to compel the irrigating water to move slowly in the orchard, thus allowing it to be absorbed by the soil, and there should be, and need be, but very little waste water if it is properly applied and looked after during the period of irrigating the orchard. It will generally be found in the interest of economy to have the best attainable appliances for regulating the supply of water from the head flume or ditch to the irrigating furrows.

THE SAN JOSE SCALE.

The so-called San Jose scale has gained something of a foothold in some orchards east of the Rocky mountains and some alarm is thus felt by orchardists liable to the invasion of this very pernicious insect. In view of the presence of this pest in Eastern orchards, having no doubt been introduced from the Pacific coast region through the importation of trees, the department of agriculture has taken the matter in hand and given a history and full description of the insect as well as remedies to be used against it. Unfortunately, the remedy most strongly recommended by the department is the least effective, so far as experience on the Pacific coast taught the best methods of eradication of this devastating insect. The best remedy against the San Jose scale, as well as against many fungus diseases of fruit trees is the lime, sulphur and salt mixture, the formula for whose preparation was fully given in the March number of *THE IRRIGATION AGE*. This formula is one of the most valuable known to orchardists and should be carefully preserved for reference. It will certainly be needed.

THINNING FRUITS.

The thinning of fruits of nearly all varieties is one of the most important branches of orchard work. Nature nearly always over-exerts herself and attempts to bring forth more fruit than the trees can properly mature. Other things being equal, the larger the fruit the larger the price obtained for it in market. Fruitgrowers generally do not attach enough importance to the proper thinning of their fruit crops. Most growers consider that operation merely incidental, and not of so vital moment as cultivation, irrigation and the spraying for disease or insects. It is doubtful, however, whether there is any branch of orchard work whose neglect tells on the bank account with much greater effect than this.

As a general proposition all fruits should be thinned. There may be exceptions to this rule as to most others, but it may be laid down as an axiom that fruits should be thinned. The proper period to do this with stone fruits is just as soon as the pit begins to harden. At this time the fruit cast off by the operation of natural cause will generally have fallen, and the vitality of the trees will not have been yet drawn upon to any great extent. Be it remembered that it is not the production of a large amount of fruit pulp that tells upon the tree so much as the maturing of the seed. This is the chief concern of nature, and it is to the maturing of the greatest number of seeds that the energies of the tree are directed. To relieve the tree, therefore, of this necessity is not only desirable in the interest of fine fruit and good prices, but is necessary to prolong the life and retain the vigor of the tree. No hard and fast rule can be given for the thinning of fruits; but Mr. J. H. Hale, the eminent peach grower of Connecticut, has stated that he could get a good crop of peaches after 95 per cent. of the buds had been killed by frost. As a general statement at least half of the fruit that sets may be profitably removed, and many foremost peach growers allege that it is better to remove three-fourths of it. Experience will soon teach the observant grower what to do, but he may safely begin by picking off one-half of the young fruit.

THE SIMON PLUM.

Experiments with the Simon plum, (*Prunus Simoni*) at the Oregon Experiment Station, would seem to indicate that the plum, so highly prized in California, is quite a different fruit when produced at the Oregon station farm. Bulletin 29 of that station, published in February last, thus describes the fruit: "The Simon plum has been growing for several seasons, but on account of its early blooming has been cut by late frost. This last season the trees were protected from the heaviest frost by spreading a light

canvas over them during the night. By this means quite a number of plums were saved and came to maturity. The fruit is very attractive to the eye, being of a dark red, mottled with the lighter shades. The stem is short; large suture; flesh yellow; very firm; clings well to the stone; good keeping qualities, having kept it in perfect condition for 30 days. The longer it is kept the darker the color of the fruit becomes. The flavor is unpleasant to the taste, being very bitter, quite equal to quinine. It is not improved by cooking. The tree makes a very compact growth, is very hardy and commences to bloom quite young. In appearance it is a fine fruit, but very deceptive."

In marked contrast with the fruit described in the Oregon bulletin is the *Prunus Simoni* as grown in California. It is quite likely that the moist climate of the sound districts and western Oregon may make of the Simon plum wholly a different fruit from that grown in the hot, dry, interior valleys of California. The fruit is of Chinese origin and its proper habitat may be quite different from that found at the Oregon Experiment Station. In Professor Wickson's book, "California Fruits," the *Prunus Simoni* is thus described: "Large, flattened, with deep cavities at base and apex; brick red or dark cinabar color; stem very short, flesh fine, apricot yellow with peculiar aromatic flavor; tree small, with large, long, oval elliptic leaves of dark, shining green; flowers small and white; reaches its highest perfection in hot, dry summer air. Light green branches of *Simoni* grow as vigorous and upright as the Bartlett pear, and are heavily clothed with unusually long, narrow, light green leaves. Very fine as an early plum; ripens with Royale Hative and ships well; large, six and a quarter to seven inches in circumference; flesh firm; rich, sweet, aromatic and delicious, with marked pineapple and faint banana flavors; pit very small.

Great care should be taken to pick up and destroy, by feeding to stock or otherwise, all fruit which drops from the trees before maturity. This work should be strictly attended to every few days, so long as there is any considerable dropping. Close attention to this will often result in a greatly increased crop in following years, and will often save the application of more expensive remedies against insect pests of various kinds. In this way plums in which the curculio is developing will be disposed of together with their maleficent inhabitants, also apples and pears which have dropped from any cause and afford breeding grounds for various pests. All such sources of danger to the orchard and loss to the orchardist should be promptly removed, and the fruit thus picked up entirely disposed of by feeding or burning. It should never be buried in manure heaps or elsewhere in such manner as to render resurrection that year or the next possible.

COLONY BUILDING IN ARID AMERICA.

CO-OPERATIVE IRRIGATION ON THE PLAINS.

By JOHN G. STEFFEE.

THESE suggestions are intended to apply mainly to river and creek valleys where irrigation by the ordinary canal system is impracticable, and where a continuous water supply of at least one hundred gallons per minute can be obtained by pumping from wells not exceeding twenty-five feet in depth. The writer's personal knowledge of locations for such wells is confined, principally, to counties intersected by the Arkansas and Cimarron rivers, and the counties of Harper, Barber, Comanche, Clark, Meade, Kiowa, Pratt and Kingman in Kansas, and although the suggestions hereinafter briefly outlined are applicable to all sub-humid areas having similar local conditions and environments, it is to southwestern Kansas especially that this paper refers.

It is now generally conceded, and is indeed a well-known fact that the irrigation of five to fifteen acres of land, by means of a light service pump of large capacity and with an ordinary wind-mill as the motive power is both successful and profitable, and the aim of "Co-operative Irrigation and the Colony Plan" is to employ the same economical and practical methods as are now used by individual farmers, with such modifications as experience, local conditions and necessities will require, and is recommended only as a means of utilizing more fully the available and favorable sites for irrigation, and for distributing the benefits thereof among the greatest number of users.

The development of this plan of irrigation need not be confined exclusively to pumping plants, but is well adapted to numerous sites where small streams can be utilized for irrigation of limited areas, and especially where reservoirs can be constructed to retain the storm waters of the smaller catchment basins.

By this term we heartily concur, so far as the local conditions are applicable in the opinion of our leading hydrographers and irrigationists, that the outlet of the catchment basin should be dammed only with the view of diverting the storm waters into ditches and conducted to natural or artificial reservoirs. The general features of this plan, we think, can be understood from the following example: Let a tract of land, varying from 40 acres to 640 acres in area, be selected according to the surface conditions and water supply, all which tract can be thoroughly irrigated from pumping plants, reservoir or catchment

basins, or by utilizing the water from a small stream in the immediate vicinity, then let this irrigated tract be sub-divided into small plats of five to twenty acres each, and allow each individual or family interested in the development and maintenance of said tract the use of one of the small plats for the purpose of raising garden vegetables, fruits, potatoes, etc., for home consumption and for market.

This plan is capable of great modification to conform to local conditions and to exigencies dependent upon private land ownership, and of many classes or conditions which might be named. We will notice only four.

First. In neighborhoods already thickly settled, a favorably located tract of land comprising forty to one hundred and sixty acres may be selected, and either purchased or leased on the co-operative or partnership plan, and irrigated by any method found to be the most economical and practicable, and the expense of development and maintenance pro-rated annually among the farmers, using such irrigated land, according to their respective interests and the amount of water or land used by each.

Second. A farmer, on whose land might be found a favorable site for irrigation, could in some instances at his own expense, put in ditches, pumps or reservoir of sufficient capacity to irrigate a portion of his farm, say 50 to 100 acres; and after retaining 20 to 40 acres for his own use as orchard, for alfalfa and for garden and vegetables, he could lease each year to his less favored neighbors the remainder of the irrigated tract, in 1 to 5 acre plats, for raising potatoes, small fruits and root crops. The annual income from such leases alone would contribute largely to the expense of maintenance and operation of the entire tract.

Third. It is well known that many, if not a majority of the most favorable sites for irrigation, in the counties intersected by the Cimarron and Medicine rivers, also along Salt Fork, Mule creek, Kiowa creek and their tributaries were appropriated many years ago by ranchmen for ranch headquarters, and are still so held. It is equally true that few, if any, of these large ranches have been profitable investments, during the last eight or ten years, and that many of them are for sale at very low prices, compared with their original cost and former supposed values. For ranch purposes exclusively, even at present prices, they are not generally reckoned as safe investments and are slow sale, and for dry farming alone they are

even more so. If 160 acres or more of land, located near the center of a ranch of 2,000 to 5,000 acres, can be thoroughly irrigated, and a hamlet of 10 to 20 families located upon or immediately adjoining such irrigated tract, allowing 5 to 10 acres of irrigated land to each family, not only could the irrigated land be fully utilized and the benefits distributed among all the families in such hamlet or village, but the entire ranch would be or could be utilized for dry farming and stock raising, and the support of such families during seasons of extreme drouth and times of extraordinary depression in the live stock market would be assured.

Fourth. The principal, and we think the strongest feature, of Co-operative Irrigation and the Colony Plan is the following: Fully 50 per cent. of the lands in some of the counties of southwestern Kansas are now owned or controlled by non-residents and mortgage and land corporations, the titles having been acquired largely by mortgage foreclosure. We think it is safe to estimate that not more than 25 per cent. of the lands, and in a few of the counties of southwestern Kansas not even 10 per cent. of the farms are actually owned and cultivated by the occupants. The problem of repopulating these farms is a serious one. The ordinary method of selling these lands *on time*, the purchaser depending on the profits of the farms to meet future payments of purchase money, will, we think, in the light of past experience prove a failure, and we are convinced that some greater inducement than the prospect of raising an immense crop of wheat for a very low price and with an occasional dry season, which renders even the wheat crop a failure and leaves the settler bankrupt, must be held out, and to some extent demonstrated before anything like active immigration can be secured for this section of the State, and we have confidence in the colony plan of irrigation as the nearest practical solution of the question of repopulating a number of the southwestern counties of Kansas, and suggest the following:

Let favorable sites be selected by the corporations having large land holdings in this section of the State; let these sites, which should consist of tracts not less than 160 acres in area, be thoroughly irrigated by any or all of the methods heretofore suggested; let them colonize ten to twenty families of Germans, Swedes, Menonites, or even Americans, especially those having a common religious belief, such as Dunkards, Quakers, etc., upon or adjacent to one of the irrigated tracts, allowing five to twenty acres of well irrigated land to each family. Here they can raise garden vegetables, fruits, potatoes and other root crops for home consumption and for market, and on the surrounding farms, within a radius of one to five miles, the colonists could, by dry farming, except in years

of extreme drouth, produce good crops of wheat, rye, barley, broom corn, sorghum, millet and other forage crops.

The social, educational and religious advantages of such colonies over those which now exist in many parts of southwestern Kansas need no comment. The practical working of such coöperative or partnership colonies has many examples throughout the United States. Such a plan is only in the remotest sense, if at all, socialistic or communistic private ownership in lands and personal property, and individual enterprise need not be in any way curtailed; and so far as the writer has been able to investigate Co-operative Irrigation and the Colony Plan has many features worthy of commendation and few which merit criticism.

A COLONY IN CONTRA COSTA.

The San Francisco *Chronicle* states that a railroad contractor connected with the Moraga ranch and California and Nevada railroad has returned from Chicago where he completed the establishment of an agency for the Moraga ranch. The entire tract, consisting of 13,605 acres, is to be cut up for small farms. About 2,000 acres, are now ready for the market in subdivisions of from five to fifty acres. A branch of the California and Nevada railroad is to be extended from Bryant five miles into the tract. On this line a town site, known as Glorietta, has been laid out. This town is on the 2,000 acres ready for market. A small outfit is now at work finishing up wagon roads and putting all the land, both town and farm sites, into shape for immediate improvement. It is a beautiful tract, fertile, well watered and abounding in charming building sites for country homes, and when rendered easily accessible for travel, and the way opened to the markets of Oakland and San Francisco, it will soon be filled with a thrifty population. Its settlement will greatly benefit the county generally.

The International Homestead Company, a corporation composed of Chicago capitalists, has just purchased a tract of 2,200 acres of land on the Santa Fé Railway at Irvington, Cal., about twelve miles northwest of San Bernardino, the consideration being \$80,000. It is said to be the intention of the new owners to divide the tract into small parcels and locate on it a colony of Eastern people.

The Petaluma *Courier* has this to say about a colony recently established between Petaluma and Santa Rosa: "Wilfred Page of the Cotati ranch reports that the property is fast being improved by newcomers who are buying small lots of land and establishing themselves in comfortable homes. They are people of a good class who will make very desirable citizens, and they are all starting in with the evident intention of being satisfied with making a living."

ARIZONA. A COLONY ON THE COLORADO.

Representatives of the French and Scotch syndicates, who intend placing a colony of wine-producers near the mouth of the Colorado river, have returned to Yuma, after having made a careful survey of the streams which leave the Colorado that can be used for irrigating the great valley of the Colorado west to the main range of mountains. Upon the arrival of the owner of the lands, Gen. Andrade, negotiations for the purchase of the lands will be closed.

ITALIAN TRUCK-GROWERS.**Mississippi is Obtaining a Population that Would Thrive in Southern Arizona.**

The people of Mississippi think they have discovered that there is a desirable class of agricultural population to be obtained from certain elements in Italy. Doubtless this is true and it occurs to us that there are places in the Arid West—southern Arizona for instance—where the same people would thrive. A recent issue of the Vicksburg *Herald* says:

"Interest in Italian immigration has been greatly stimulated by the various articles in the public prints referring to the subject. It has been remarked that for examples of the thrifty prosperity of Italian agriculturists and truck-growers, as well as of their adaptability to the climate of the lower Mississippi valley, it is scarcely necessary to go as far as Friar's Point. Similar instances are numerous in the vicinity of Vicksburg, and for some years past several Italian families have been farming successfully on Big Black.

"The Italian residents of Vicksburg take a decided interest in the movement and so far as heard predict the most favorable results from it, both to those who may come here and to the country. Several years ago one of these, a citizen of prominence, said it would be an easy matter to induce Italian immigration. It was only necessary to advise the immigrants wanted of what they could depend upon securing here and to assure them that their coming would be welcome to the resident population. Their industry he said, would effect a revolution in agriculture and make this the richest portion of the South. As to their thriving here he had no doubts whatever.

"Vice-Consul N. Piazza, a resident of this city for many years, said yesterday that he had received a letter from the Italian consul at New Orleans on the subject of immigration. Mr. Piazza, who is necessarily thoroughly posted through his long residence in this State, is in a position to render his homeseeking countrymen and the communities which desire their assistance in agriculture, valuable assistance. He spoke with approval of the plan and had evidently the fullest confidence in the ability of his

countrymen to take hold of the advantages offered them in the delta as well as the uplands."

Sixty families from Indiana are talking of settling in Phelps County, Neb.

A car load of Russians direct from Russia is enroute for Chamberlain, S. D. and immediate vicinity.

There's an effort on foot to colonize a lot of Italian farmers in Barber county, Kan. This is an industrial and not a political scheme.

F. E. North, formerly a resident of Iowa, but now making his home in Mexico, is in Chicago trying to organize a colony to go into Mexico, and work his coffee plantation. If he is successful he will go into the coffee raising business quite extensively.

California boasts of a number of women farmers who manage large estates, make money, and keep healthy and happy. Of course, the comforts of farm life are greater than they are in the east, and there is a possibility of gaining more than a mere living. Some of the women farmers have won more than mere local fame.

The supervisors have directed the district attorney to draw up a resolution relative to the incorporation of Pleasanton, Colorado, as a town in accordance with the petition of the citizens of that community. The population of Pleasanton is 937.

The town of Fruita, in Mesa county, has been incorporated.

The editor of the *Electrical Age* predicts that by the year 1900 our homes will be heated by electricity supplied from large central stations and distributed through street mains. The idea is practicable even now, the economic factor being the only one as yet unsolved.

Western America is the name of a new irrigation publication issued monthly from Omaha. The North Platt valley receives its full share of attention, and in the last issue especially so, as a comprehensive write-up of Gering and the two counties of Scotts Bluff and Cheyenne appears from the pen of G. H. Lawrence.

Irrigation is making an impression, and gaining ground rapidly. The papers of the East are giving ten times the space to this class of news from the West that they did two years ago.

The county horticultural society idea is spreading fast.

PULSE OF THE IRRIGATION INDUSTRY.

BROKEN DAM IN IDAHO.

THE breaking of a reservoir dam, causing a serious flood and suspension of traffic over the railway in Idaho in March, may result in good to irrigation enterprises all over the country. While the reports sent out were greatly exaggerated as to damage done, it was great and serious enough. The breaking of the dam put in by the Orchard Irrigation Company of Idaho for storing water swept away bridges, railroad tracks and embankments.

While Nampa, Caldwell and the railway company lost much by this flood, to Idaho, and in fact to all the arid regions of the west, it is liable to bring irreparable losses. For years the friends of irrigation have been advocating and urging storage reservoirs as among the most important enterprises in the line of irrigation. Where such have been securely made the results have been all that enthusiastic engineers claimed for them, and capital has been seeking investments in such enterprises.

The breaking of this dam, however, should result in good in one direction. It will bring about stronger and better construction of dams, and it ought to result in discarding all exclusive earthwork in dams, unless the locality furnishes the right kind of soil or clay to make embankments, which will neither wash, dissolve nor permit seepage. While interested persons claim that this dam was properly constructed the facts as learned from good sources seem to show otherwise. The point selected for the dam was in a canyon nearly fifty feet deep, 100 feet wide at the bottom and 200 feet wide at the top. Here was where the great pressure was to come, while all above this consisting of wings were only low levees, all of the 2,800 feet in dam and wings being sixteen feet wide on top. The slope on the upper side was a rise of one inch in two inches, while the lower side had a slope of one and a half in two inches. This gave a base of 225 feet at the bottom of the dam, which, if made of good clays, would have been ample for much greater pressure than a height of fifty feet of water would ever exert on it. A cut eight feet deep was made across the bottom of the canyon and a stone wall, laid in cement, one foot thick and nine feet high, was placed to prevent seepage. This wall was also extended on the sides where needed. This wall came one foot above the natural surface, and on the upper side of this dirt was placed in layers

one foot thick, twenty feet wide and clear across the canyon for puddling. This puddling was accomplished by wetting these layers by means of pump and hose until well soaked, and then it was packed by means of a two-ton roller drawn by animals. If proper material was used in this construction it seems that it ought to have stood for all time. The outlet of water for use in irrigating land was through a firm tunnel in solid lava, while a waste weir, also in lava, cut six feet deep and 150 feet wide was ample to prevent the water ever rising above a point six feet below the top of the dam and its wings.

Work began on this dam in November, 1892, and was completed in May, 1893. Doubtless some frozen ground went into the dam. In 1893 the water rose to a point 14 feet below the intended high water mark and the dam did not leak. The water was exhausted during the irrigating season, giving the dam considerable time to dry out before the fall rain filled it again up to a much lower point. This was let out in November, permitting the dam to remain dry until it was rapidly filled in March last by rains and melting snow, until it had reached a point four feet higher than ever before, and yet 10 feet below high water mark, when the dam gave way, taking out all the high dam at the bottom 100 feet long, and about 150 feet wide at the top. Nearly all over the Snake River valley the earth is a mixture of quick and granite sands, alkalis, ashes, etc., readily dissolved or made into paste by being wet which, in drying, cracks and leaves open crevices running in various directions. It is most probable that that portion of this dam which was puddled had many crevices formed giving a chance for the water to work its way through. Had this dam been constructed with a light stone wall, so tight as to prevent water leaking through, or even with a lumber filling or bulk head, it is reasonably certain that the structure would have withstood the force of the water, except that the time of the face of the earthwork may have been too steep. Again it is probable that in drying out the shrinkage caused its destruction. This idea is emphasized in the fact that the Mountain Home dam, 20 or 30 miles east and of about the same height, is all right after having been well tested two seasons. Better soil, better construction and more care in puddling made the Mountain Home dam a success and safe structure.

CONVENTION AT MCCOOK, NEBRASKA.

The irrigation convention at McCook, Nebraska, closed lately. A permanent organization was effected with L. Morse of Dundy as president; S. P. Hart of McCook, vice-president; R. L. King of Culberston, secretary and E. D. Willett of Harlan county, treasurer. The last day was profitably spent in discussing such topics as "Applied Irrigation," "Intensifying and Aiding Horticulture," "Windmills and Other Methods of Raising Water," and hydraulic engineering as applied to irrigation and perfecting and drafting suitable and needed changes to the present irrigation laws for presentation to the coming legislature, and committees appointed to push the same. Among the changes proposed is one giving farmers the right to incorporate and condemn suitable land for reservoirs and storage basins. Much enthusiasm was manifested and much good is looked for from the meeting.

SEWAGE IRRIGATION.

Sewage as a fertilizer has been successful wherever used. In some localities in Germany it stands in high favor. A unique system of sewage irrigation will be adopted for lands of the Los Angeles plains, which lie between the city of Los Angeles and the Pacific ocean. The outfall sewer of the Los Angeles city extends a distance of fourteen miles from the city limits to the sea; 6,000 feet of this conduit consist of a cemented brick tunnel six feet in diameter; the remaining portion is 48-inch wooden pipe. Numerous hydrants and water chambers have been constructed along the line of this sewer from which laterals will be extended. By the operation of gates constructed in the main conduit the water flowing in the sewer will be diverted and forced into these chambers and through these hydrants, thence through the laterals to the lands upon which it will be utilized.

IRRIGATING IN MEXICO.

A large survey corps have been engaged for the past three months in surveying the route for a canal necessary to irrigate 100,000 acres of land in the neighborhood of Camargo, in the State of Tamaulipas, where the soil and crops are similar in every respect to the soil and products of the Delta of the Nile in Egypt, and for which the company hold a valuable concession from the Federal government. The contemplated expenditure on this work is \$750,000. What engineering difficulties have arisen are all encountered on the first $\frac{3}{8}$ kilometers from the head-gates of the canal. A 1,500 foot tunnel and a kilometer of open cut, some twenty-five feet at its deepest part, together with 5,000 feet of fluming along

the steep bank of the river San Juan, are the chief works, in addition to the main dam and head works. The balance of the undertaking is all plain sailing. The canal will start out with a bottom width of twenty-five feet and a depth of water of seven feet, decreasing in size as the canal runs easterly and distribution goes on. Provision has been made for 40-50 kilometers of lateral or distributing canals, with regulating gates, to divert and measure out water from the main canal. Ninety kilometers of telephone wire and five instruments will form part of the undertaking, and on looking over the plans and estimates we doubt if any more complete and carefully conceived engineering scheme has ever been put before any company in Mexico. Irrigation is bound to play a prominent part in the future of this country, and the example of this company should do much to promote undertakings of this kind. We are of opinion that there is no better investment at the present time than irrigation, that is, if the enterprise is founded on a sound engineering and financial basis.—*Mexican Trader*.

TEXAS IRRIGATION SCHEME.

There is an enterprise on foot to irrigate five hundred thousand acres of the rich Prieta grant situated in El Paso county, Texas, and bordering on the Rio Grande river and extending east as far as the town of Sierra Blanca. The proposed irrigation ditch will originate in New Mexico, sixty miles north of El Paso, and will receive its supply of water from the Rio Grande river. The entire number of acres in the grant is 2,647,042. The mother ditch will be one hundred and thirty miles long, and will then branch out into lateral ditches, covering the most available portion of the grant. The syndicate which is to undertake the enterprise is composed of a number of wealthy people of Chicago, St. Paul and Europe.

SAN SABA RIVER VALLEY.

A large mass meeting of the citizens of San Saba, Texas, was held during April, to listen to a proposition from parties representing a California and New Mexico syndicate, proposing to put in a dam on the San Saba river about seventeen miles above the town for the purpose of irrigating the rich and fertile San Saba river valley. The parties want 40,000 acres for irrigation and a large part of this amount was subscribed at the meeting, and no doubt the whole amount will be subscribed as there are now several farms being irrigated, bringing their owners large returns, and this business is no experiment, but a success. The people are enthusiastic over the matter, as this will insure railroads, factories, etc.

NEBRASKA NOTES.

The irrigation association of Alliance proposes to make a test of raising water with windmills for irrigating purposes as a part of their line of experiments. Two wells will be put down and the pumps operated by a large windmill. The result will be watched with much interest, for if sufficient land can be irrigated by that method to make it profitable a great many will prepare to put in such plants.

The farmers of Cherry county are making preparations to irrigate on a small scale this year by the use of wind.

The Standard Cattle Company of Ames has had everything in readiness for the putting in of a large sugar beet crop this year, conditioned upon the granting of the ditch, and will now begin at once to push the planting of about 700 acres. The ditch will be about nine miles long, twelve feet wide at the bottom at the start and twenty-eight feet wide at the bottom where it empties into the Platte. The cost will probably be about \$15,000. It will run diagonally across the valley at a point at the foot of the bluffs north of North Bend to a southwesterly direction, emptying into the Platte a couple of miles above Ames.

W. F. Cody evidently intends to carry out his views on the irrigation question in a practical way. He has a large force of men engaged in constructing an irrigating ditch on his ranch at North Platte which when completed will furnish water for 2,000 acres of land. The land will be divided up into 80 acre tracts and leased.

There are about fifteen teams working on the Nine Mile Canal, which was commenced last fall. The canal when finished will be 20 feet wide on the bottom and 20 miles in length, and will reclaim about 10,000 acres of land. B. F. Gentry is superintending the work.

There is quite a force of teams at work on the Lawrence canal, hauling rock and riprapping the dam at Reservoir No. 2, which, when finished, and the reservoir filled with water, will make a lake covering an area of about 400 acres and will average over ten feet in depth. They are also cleaning out the ditch and preparing to turn the water in. This canal was finished last season and will water about 1,500 acres this season. Laterals are now built and land prepared to water that amount.

Water has been turned into the Winters Creek ditch, Miniature ditch, Castle Rock ditch and Mitchell, also several of the smaller ditches. Work is expected to commence on the Farmers' canal soon. This is a high line canal on the north side of the river, twenty miles is now completed, and when it is all

completed will be 75 miles in length and will water 75,000 acres of land.

COLORADO ITEMS.

Colorado has 3,000,000 acres under artificial irrigation. The farm products exceed \$12,000,000 a year. There are 1,500,000 cattle, 2,000,000 sheep. The coalfields cover 40,000 square miles. The supplies of marble, granite and other building stone are inexhaustible.

It has been decided by the citizens of Grand Junction valley to memorialize Congress to build two large canals for the purpose of reclaiming lands in Western Colorado and eastern Utah. The estimated cost of same is \$5,000,000.

The seepage from the High line ditch near Castle Rock is sufficient to form quite a stream of water.

S. W. Winn, general manager of the Syndicate Lands and Irrigating corporation at Kansas City, Mo., after returning from a ten days' trip inspecting the farming operations and irrigating system of his company in western Kansas, said that his observations were confined to Kearney and Finney counties, where in one day's drive he had noticed more than 150 windmills and reservoirs that were being used to irrigate small farms of from one to fifteen acres each, according to the capacity.

The season so far has not been calculated to lessen the interest in irrigation. The thing for every farmer in western Kansas to do is to put in a pumping plant and bid defiance to drought.

There are three full fledged irrigation plants in Stafford county, Kansas.

J. S. Emery, of Lawrence, Kan., national lecturer on irrigation, says that he will be present at a mass convention in Minneapolis, Minn., early in June, in the interests of irrigation. With him will be Prof. E. R. Moses, of Great Bend, Kan., president of the Interstate Irrigation Association. Prof. J. E. Todd, of Vermillion, state geologist, President McLouth, of the South Dakota Agricultural College, Dr. Wm. Blackburn, president of Pierre University, and other prominent people will also attend.

An irrigation convention will be held at Hoxie, Kansas, on the 11th of May. The whole country is invited and several well informed speakers on the subject of irrigation will be present.

Irrigation would make of southwest Texas a veritable homeseeker's paradise—unsurpassed for stock growing and agriculture.

THE WOOL MARKET.

New wools from the Bright Wool Stations have begun to make their appearance, but the receipts are hardly large enough, however, to establish a market on all grades. All wools showing a long and strong staple, whether coarse, medium or fine, are readily salable at full market value. Old lots of Territory wools of good staple are hard to find, therefore new wools that are well grown find a ready market. There are orders waiting from manufacturers for such wool, whether grown in the central or western states, at full prices. Any further information on wool will be furnished by Silberman Bros., 214 Michigan street, Chicago.

The farmers living on the south side of the South Platte river, from old Fort McPherson to a point opposite Gothenburg, have organized an irrigation company, and are now engaged in their final survey. They will commence excavating in June. Silas Clark, of Cottonwood Spring, is managing.

Colorado has 3,000,000 acres under artificial irrigation. The farm products exceed \$12,000,000 a year. There are 1,500,000 cattle, 2,000,000 sheep. The coal-fields cover 40,000 square miles. The supplies of marble, granite and other building stone are inexhaustible.

Magnolia avenue, Riverside, Cal., is fifteen miles long, 132 feet wide, and lined by three rows of pepper, eucalyptus, palm and magnolia trees.

California exhibits a sweet potato from Fresno that weighs 44¾ pounds, and a peach from Bakersfield that weighs 23 ounces.

Utah is blessed with Territorial tree inspectors who inspect. It is the best method of keeping the orchards free from pests.

News from several points in Florida indicates that the settlers in that state are adopting the irrigation idea rapidly.

Boise City, Idaho, is to have a fruit cannery.

DECISION OF COLORADO COURT.

A case of the utmost importance to all water users has been passed upon by the Court of Appeals. The *Denver News* says of it: "The Court of Appeals rendered a very just and far-reaching opinion on Monday affecting the rights of farmers who have bought and paid for water, and the obligations of ditch companies to fulfill their contracts. It appears that the Rocky Ford Canal, Reservoir, Land, Loan and Trust Company had sold to Mrs. Mary A. Simpson a certain amount of water which it failed to deliver. As a consequence her crops dried up. She brought suit for damages and obtained a judgment in the trial court. The defense set up was that the canal was a long one, that it had broken in several places, and plaintiff's farm being at the lower end of the ditch it was impossible to get water to it. The case was carried up to the Court of Appeals, which has affirmed the judgment. The practical effect of the decision is that ditch companies must comply with their contracts or suffer the consequences. Heretofore

they have not done so. For years they have been robbing the farmers of the state by collecting water rents in advance and then delivering the water or not as the same was convenient. If the farmer failed to get his water, and lost his crop, he did not even get back the money he had paid for it. He lost money, labor and crop. This opinion will put an end to this species of robbery."

APPROPRIATION OF WATER.

The following is the Wyoming Supreme Court decision on the water right question, delivered February 15, 1894:

MCPHAIL v. FORNEY et al. The board of control fixed the amount of water which a ditching company should take from a certain creek, and described the land to be irrigated by such water; and the ditching company decided to plaintiff a four-fifths interest in the ditch, and "the water therein contained," and one-fifth interest to the defendant. Held, that the plaintiffs were entitled to enjoin defendant from diverting more than one-fifth of the water from the ditch, though he owned more than one-fifth of the land to be irrigated thereby, where he failed to show that water was actually and rightfully being used on his land when he acquired title, or that plaintiffs acquired their water rights after he had acquired title to his land.

Error to District Court. Carbon county; Jesse Knight, judge. Action of William G. Forney individually and as administrator of Mollie Forney, deceased, and Jane P. Dillard, to enjoin Donald McPhail from diverting for irrigation purposes more than one-fifth of the water in the ditch of the Forney Ditching Company. From a judgment for plaintiffs, defendant brings error. Affirmed.

CONWAY, J. It is alleged in the pleadings by the parties to this action, both plaintiffs and defendant, that the defendants in error own a four-fifths interest in the irrigating ditch known as the "Forney Ditching Company's Ditch," and that plaintiff in error owns a one-fifth interest in the same ditch. Plaintiff in error, however, claims the right to divert from said ditch and use more than one-fifth of the water carried by it. The parties, plaintiffs and defendant, both claim under an order of the board of control, dated March 24, 1892, determining and establishing in the Forney Ditch Company a right by two appropriations to 6.28 feet per second of time of the water of Jack creek, and describing the lands to be irrigated by this water. The parties to this suit now own the ditch in the proportions stated, deranging their respective titles from the Forney Ditching Company by the deeds purporting to convey to them their respective interests in the ditch and "the water therein contained." As held in the case of Frank v. Hicks (decided at the present term), 35 Pac. 475, a right to the use of water for irrigation purposes, together with the ditch or other conduit for the water, may be conveyed separate from the land upon which the water is used. It seems that this is what has been done with the water right involved in this action. Plaintiff in error claims the right to divert and use more than one-fifth of the water carried by the ditch in question, although he claims but one-fifth interest in the ditch, because, as he claims, he owns more than one-fifth of the land for the irrigation of which the appropriation of water was made by the Forney Ditching Company and allowed by the board of control. This claim is not consistent. If he has acquired by the purchase of the land the right to divert and use more than one-fifth of the water carried by the ditch, he would, at the same time, acquire more than one-fifth interest in the ditch as necessary to the enjoyment and use of the water right. According to the principle announced in the case of Frank v. Hicks, and a number of cases cited therein, when a party who owns land, and a water right and ditch, used for the purpose of irrigating the land, conveys the land, the water right and ditch pass by the conveyance of the land. But plaintiff in error does not, by his pleading or evidence, bring his claim within the operation of these principles. He does not show that water was rightfully and actually being used on his land when he acquired title. He does not show that the conveyances of the different interests in the water right acquired by the Forney Ditch Company were not made before he acquired title to his land. Plaintiff in error also forgets that it is just as necessary to the creation and preservation of a water right to provide means for the continual diversion of the water from its natural channel, and for conducting it to the place where it is applied to some beneficial purpose as it is to apply it to the beneficial purpose. Plaintiff in error claims a right to the use of more than one-fifth of the water furnished by the ditch mentioned. This claim might well be decided against him on the pleadings as well as on the evidence. This is the only question of interest involved. Some errors in the proceedings in the District Court and in its findings are assigned, but they are not material to the decision of this question, and, if error, are not such error as to authorize a reversal of the decision. The District Court, by its judgment and decree, granted a perpetual injunction generally restraining the plaintiff in error from diverting from the ditch known as the "Forney Ditching Company's Ditch" more than one-fifth of the water carried by it, but in certain contingencies allowing him more than one-fifth. The judgment and decree are at least as favorable to plaintiff in error as the facts warrant, and it is affirmed.

Groesbeck, C. J., and Clark, J., concur.

CANALS.

Colorado.—The Citizens' Water Company has sent a small force of men to commence work on its proposed reservoir at the mouth of Goose creek, on the South Platte river.

Alberta.—Mr. A. W. Ponton, Indian department surveyor, is now at the Blackfoot reserve superintending the construction of the irrigation ditch commenced last fall. About 200 Indians are employed on the work, which will shortly be completed it is expected. . . . The irrigation ditch put in by Mr. McMillan last year for Mr. Potter of High River is now at work. Though the water was run into this ditch very late in the season for the first time yet it proved a great success, and it is expected that very satisfactory results will accrue from its operations this year. . . . The irrigation ditches are now at work in the Springbank district. The water is being used all over that section where the ditches are in operation.

Wyoming.—J. M. Brockway, Alexander Brockway, James A. Brockway, David S. Brockway, Willard Virden, G. W. Dickson, Mrs. Matilda Foggett and Miss Maggie E. Brockway, of Douglas, have just located 2,000 acres of the choicest land on the Fort Fetterman reservation near Douglas. It is the intention to at once begin the construction of an irrigating canal from the Platte river to irrigate the lands. The survey for the ditch has already been completed. The selection comprises some of the finest agricultural land in the state, and the development of the tract will mean a great deal to the city of Douglas. . . . Work has been begun, under the direction of Captain Ray of the Shoshone agency, on the immense irrigation ditch on Mill creek. When completed, a large body of agricultural land on the reservation will be watered.

South Dakota.—The ditch at Edgemont is progressing finely. It will be completed in time for use to water this year's crop. The ditch is large enough to furnish a 40-horse power reserve of water to be used for manufacturing purposes. There are about 3,000 acres of land yet unsettled that are accessible to the ditch. Two large reservoirs are to be built for storing the water when not in use on the land.

Utah.—The necessity of a high-water canal is becoming more apparent every day. The people who own land near Wasatch for which they have no water begin to realize that unimproved land is a continual expense and no profit whatever. They are getting thirsty for high-water, and it looks as though they were, at last, making an effort to get it. According to recent estimates, a high-water canal from the river can be brought through for \$10,000. This canal would bring under cultivation over 2,000 acres of land. According to this figuring, the water right would not cost more than \$5 per acre. It would reclaim 2,000 acres of land that to-day are non-producing, and, practically speaking, worthless. With the canal built, this land would be worth at least \$25 per acre, or an aggregate of \$50,000. To put this canal through every acre of unimproved land under the canal should be represented in the scheme. If one man owns more land than he can work out water right for, there are plenty of young men who would be glad to work on the canal and take land for it. The scheme seems to be feasible.

Nebraska.—The irrigation ditch which is to be run through the northwestern part of the state has been commenced near Rushville. The estimated cost for the constructing of the ditch is in the neighborhood of \$2,500,000. . . . A number of enterprising people living at or near Brady Island are taking initiatory steps to construct an irrigation ditch in that neighborhood. . . . There is a full head of water in the irrigating ditches of Dundey county, and the farmers are making good use of it. . . . There was a meeting of all persons interested in the big irrigating ditch which it is proposed to construct from the lakes in the southern part of Cherry county through Brown, Rock, and Holt counties. A number of Omaha men are largely interested in the territory through which the proposed ditch would pass, and the promoters are confident of enlisting their assistance in pushing through the project. Competent authorities estimate that there is an ample supply of water to irrigate 300,000 acres. At the irrigation meeting a resolution was passed that it was the sense of the meeting that the ditch should be built, owned, operated and controlled by home enterprise. Remember, if some foreign company builds this ditch you and your children's children forever will pay tribute to it. . . . It reports that as a result of the current agitation over 100 miles of canal are being constructed in Lincoln county by six different companies. . . . Water was turned into the Belmont canal as far as Pumpkin creek recently. There have been about thirty-five teams at work cleaning sand from the canal, under superintendency of Engineer Lawrence. . . . The irrigating ditch begun at Rushville is mapped out for a distance of two hundred miles, and will cost about \$2,000,000.

Washington.—F. A. Twichell, as secretary of the Lake Washington Drainage Canal Company, has issued the following notice of a meeting to be held in the Chamber of Commerce rooms: "Notice is hereby given that a meeting will be held in the city of Seattle for the purpose of the incorporation of the Lake Washington Drainage and Canal Company. All who intend to participate in the movement to open a waterway from Lake Washington to the Sound for the purpose of relieving the overflowed districts, and especially all those who intend to subscribe money or land to that end, or to join in the incorporation, are requested to be present at that time, as it is the intention to begin active work at once."

NEW COMPANIES.

California.—Hesperides Garden Co., incorporated, Los Angeles; \$25,000. Dealing in real estate and water rights; cultivating orchards and vineyards. April 18. . . . Fresno—The Walters Ditch Co., incorporated, by Henry Walters, of San Francisco, Wm. Helm, Henry Walters, Jr., Henry Pero and Jas. Stevens, of Fresno. Capital stock, \$5,000.

Colorado.—Articles of incorporation of the Keirnes Lateral Irrigation Ditch Co. have been filed with the Secretary of State for the purpose of constructing a lateral ditch to be connected with the canal of the Water Supply & Storage Co. in Weld county. W. H. Keirnes, S. T. Wells and J. B. Holmes are the incorporators. . . . The Fort Morgan Reservoir & Irrigation Co. has been incorporated with \$150,000 capital stock by farmers in that section of the country. . . . The Sedgwick County Irrigation Co., capitalized at \$100,000, to operate in Logan and Sedgwick counties with the principal office at Julesburg, has been incorporated by B. Beatty, Peter Peterson, E. J. Walrath, B. Ballas, J. W. Shedd and J. S. Camahan. . . . The Farmers' High Line Canal & Reservoir Co. has filed amended articles of incorporation with the Secretary of State, placing the capitalization at \$75,000, and making the stock assessable, providing however, that no assessment shall be made for more than 10 per cent. of the amount of the capital stock for any one year, and that after the first assessment which may be made by the directors, no further assessment shall be made without a majority vote of all the stockholders. . . . Delta—The Granby Ditch and Reservoir Co., incorporated; capital stock, \$7,000; operating irrigating ditches, etc. . . . The Wolfe Drain & Water Supply Co. has been incorporated by James Wolfe and others, with a capital stock of \$5,000.

Idaho.—Articles of incorporation of the Riverside Irrigation Co., Limited, have been filed with Secretary of State Curtis. The company propose to extend the Methodist ditch, which is taken out near Caldwell, about 15 miles down the river. A plan under which the company is working is to give each purchaser of water rights an equal amount of stock. By this method the consumers will, in time, own the ditch. The directors of the new company are Judson Spofford, W. P. Hard and A. J. Wiley, of Boise; D. W. Ross, of Payette; I. H. Lowell, of Riverside. The capital stock is \$150,000. . . . The Payette Valley Irrigation Co. has filed with Secretary of State Curtis notice of the appointment of D. M. Hollins, of this city, to be an agent of the company. . . . Articles of incorporation of the Crook Irrigation Co. have been filed with Secretary of State Curtis. This is the company headed by A. J. Crook, of Payette, that has purchased the Last Chance ditch at Emmett, which it is proposed to extend to Payette. The capital stock of the company is \$100,000, \$16,000 being paid up. The directors are A. J. Crook, A. A. Branthoover, R. Pearse, E. Antz and C. L. Haines, all of Payette.

Nebraska.—Elkhorn Irrigation Co., O'Neill; \$25,000.

Texas.—The Jefferson Land, Loan and Irrigation Co. has been organized, the purposes of which are to buy, sub-divide, improve and sell on the installment plan, real estate; also to loan money on real estate security. The authorized capital of this corporation is \$250,000, in shares of \$100 each. The directors for the first year are D. A. Bibb, G. L. Nash, Geo. W. Carroll, Thos. H. Langham, L. P. Odgen, W. B. Dunlap, Guy W. Junker, John N. Gilbert and Jas. H. Rachford. . . . An artesian well will be sunk by E. M. Cook at Pearsall, Texas; capital stock, \$60,000.

South Dakota.—Articles of incorporation were filed by the Brown & Richards Co., of Huron, with a capital stock of \$100,000. Its purpose, the buying and selling of real estate and locating colonies. Directors: E. P. Soper, Charles S. Sinclair, James N. Brown, R. O. Richards and Andrew Riegle. And for the Hetland Building and Loan Association, of Hetland, Kingsbury county, with a capital stock of \$500,000. Incorporators: W. H. Egan and others.

PUBLISHER'S DEPARTMENT.

KERN DELTA COLONIES FOR THE AVERAGE MAN.

THE property of the Kern County Land Company in California still ranks among the first of the interesting and important irrigation enterprises in this country. New properties of the kind are constantly being developed, but it seems altogether likely that for the next ten years, as for the past three years, the Kern Delta Colonies will occupy the foremost place in their line.

The past season has been very successful for this company but it may be confidently predicted that next season's results will surpass anything in the history of the enterprise. The advantages which the company possesses are many and marked. While it is true that California is relatively a small part of Arid America as a whole, it cannot be denied that it is the part in which the people of the wide world feel the greatest interest to-day. Probably there is no man in the United States who, if he has never visited the Pacific coast, does not desire to do so at the first favorable opportunity, just as every well-to-do American hopes sometime to visit Europe. California is said to be about the only State in the West thoroughly well known on the other side of the Atlantic. The romance of the discovery of gold, the fascination of a winterless climate, the prodigal production of fruit and flower and tree, and of all the products of the field and garden, the grandeur of the mountain scenery—these are the peculiar charms on which the fame of California rests. Other states and territories have charms of their own. The day will come when they will be known, perhaps, as well and favorably as California, but that will be in the future. California is the land of to-day.

Now, California presents a wonderful variety of resources and even of climates. It is a very great State. Its mountain topography is such that a man

may gaze on great banks of snow while plucking roses in his dooryard during the month of January. There are places in California where land commands very high prices and where water is mined from the mountain side, just as gold is sought, and sells in an eager and thirsty market for prices which suggest the yellow metal again. Then there are other places where land and water are very cheap. It is the strength of the Kern county proposition that it represents a happy medium between these two extremes.

The high-priced land and water are only within the reach of those who can command considerable money. The low-priced land and water are located in new and remote districts where the hardships of pioneer life must be endured. *Kern county is a field for the average man.* It makes very moderate demands upon the settler's means. The men who are guiding this enterprise want good, honest settlers who shall locate there with the desire and expectation of becoming a productive and independent people. Knowing the capabilities of the soil, they realize that nothing will enhance the value of the land and command the confidence of the public like a hundred examples of prosperity on the part of a hundred new settlers. Winter homes in California are all right, and Kern county is a delightful place for them, but the aim and object of the Kern Delta Colonies is to build up a population composed of industrious and happy families who shall enjoy an even prosperity won from the soil by means of scientific irrigation. That makes a country worth having and one that will endure through all the vicissitudes of good, bad and indifferent times. And man who is ambitious to have a home, and possesses a small amount of ready means, can readily make a start in Kern county. What the company seeks is the steady development of its

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property. It demands little more than the evidence of good faith on the part of the settler.

We say that these colonies present a great field for the average man because the price of land is reasonable and a perpetual water right accompanies it, while the annual charge for water is intended to be no higher than is required to meet the cost of maintenance. The man who possesses more than the average means will perhaps desire to pay \$200 to \$400 per acre and locate in a neighborhood which he will regard as more exclusive. The man who has no means at all will locate where he can take land from the government and meet his payments from his early crops. The average man will prefer to go where land and water can be obtained on reasonable terms, where the irrigation system is to-day complete, where the people he is dealing with are able to carry out their programme of development without interruption, and where the settler will be surrounded by people who desire to build up their fortune by industry and thrift. All these requirements are met to a remarkable degree by the conditions existing in Kern county.

There is another great advantage which settlers of to-day and the future will have in Kern county. They will have the benefit of the rich and suggestive experience of thousands who have gone before them as California colonists. They will avoid their mistakes and profit alike by their successes and their failures. For instance, the people of Fresno county will teach them that there is such a thing as producing too many raisins; that there is such a thing as over watering their lands; that there is such a thing as spoiling the market by over shrewdness. The mistakes of Fresno county will not be repeated in the Kern Delta. On the other hand, the people of the San Bernardino valley will teach the new settlers that the exclusive production of oranges is an economic absurdity. So on every hand the settler of 1894 and all the years of the future will benefit by the experience of those who preceded them in the fertile and picturesque valleys of California. The great lesson which is being taught all over California, and for that matter all over the world, is that the farmer should produce what he consumes and thus guarantee the independence of his family, while adjusting his surplus production to the character of his land and market. This is the subject of profound study to-day, and nowhere more so than on the broad acres watered by the river Kern.

THE IRRIGATION AGE is constantly receiving evidences of aroused interest in the subject of colonization. On every hand plans for the making of new colonies are broached. It occurs to the writer that no other place presents such attractions to those who are organizing undertakings of this nature as Kern

county. While this company has dealt mainly with individual settlers, we are reminded by the fact that they recently disposed of a body of 1,100 acres that they would be willing to deal in this way with organized parties of colonists. The promotion of colonization is at once the most profitable and inspiring task open to enterprising men to-day. The man who engages in it successfully will do a good thing for those who buy land of him, a good thing for the country, and a very good thing for himself. There are hundreds, perhaps thousands, of neighborhoods, in the Mississippi valley, in the Ohio basin and in the northeastern and southern states where a man, having the confidence of the local public, could easily organize parties of colonists to-day. They could select desirable tracts in Kern Delta, map out his scheme of attractive farming, make up parties of homeseekers, and soon start a steady stream of people in the right direction. Parties desiring to avail themselves of an opportunity of that sort would do well to correspond with the Kern County Land Company.

This company pays more attention to its literature than almost any other enterprise. Intending settlers can obtain material illustrating the irrigation system, the location and character of the lands, the kind of homes that are generally built and the cost of building them, the various crops raised, including cost of production, selling prices and profits and everything else which the settler desires to know. Address S. W. Fergusson, agent, Bakersfield, Cal., or Chicago office, Chamber of Commerce building.

W. W. MONTAGUE & CO.

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SINGLE AND DOUBLE RIVETED.

WATER PIPE

Made in Sections of any Length Desired
12 to 28 Feet.

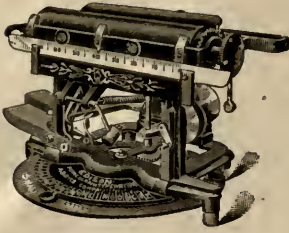
The Cut on the left shows a Section of Five joints
of pipe.

DOUBLE RIVETED IN LATERAL SEAMS.

Particular attention given to Coating Pipe with our "EUREKA" Composition, a Special Mixture Containing No Coal Tar. Iron Coated with this Composition is Rust-Proof and Rendered Impervious to the Alkalies of the Earth, is Practically Indestructible.

Iron Cut, Punched and formed for Making Pipe on the
Ground Where Required.

309-317 Market St., San Francisco, Cal.

THE EDISON MINEOGRAPH TYPEWRITER.

The accompanying cut shows the Edison-Mimeograph Typewriter, manufactured by the A. B. Dick Company. This machine takes the place in the mercantile world which is now vacant and waiting to be filled by a first-class machine at a low price, and which will do good work. There are a large number of business people who do not now use a typewriter because of the cost of the standard machines. Probably seventy-five per cent. do their own work, consisting of, on an average, a few letters a day. In fact, probably a majority of those using standard typewriters to-day could get along with the low-priced machine as well, provided it did the work, and would have bought one, had there been, at the time they purchased, a practical one on the market—which there was not. There are plenty of low-priced typewriters in existence to-day, but the majority of them are mere toys.

The printing on the Edison machine is accomplished by moving with the right hand an almost frictionless pointer to the letter desired, and gently touching the printing key with the left—two movements. The average speed in pen writing is probably about fifteen words a minute. The Edison will produce double that speed and, with a fair amount of practice, still more. The quality of the work is equal to the best, it has the same type as the Remington, it is of the type-bar variety with an inked ribbon, and of a mechanical principle peculiar to itself. The parts of the machine are so few in number and so simple in construction that there is nothing to get out of order or become disarranged. The machine has all of the characters found on the standard machines, is a heady manifold, having steel type and a hard platen, and does mimeograph work equal to the best. The weight of the machine is under ten pounds, hence it is exceedingly portable. It is as durable as the highest priced machine on the market. See ad on outside back cover.

FOR SALE.—First-class medium-sized hotel property in a rapidly growing town. House furnished and doing a nice business now; growing better all the time. Price for property, \$16,000; \$5,000 cash, balance on long time, reasonable interest. None but first-class responsible parties need apply. For full information address Fred R. Reed & Co., North Yakima, Wash.

E. L. Lomax, the general passenger agent of the Union Pacific railway, has prepared a book describing the progress of irrigation along their lines. The book is most carefully compiled, and gives the latest and most valuable information obtainable. Mr. Lomax is a wide-awake, active friend of irrigation.

A new method of mining, milling, roasting and smelting different kinds of ores has been successfully demonstrated in Germany and is now being introduced with unprecedented success. The slow and cumbersome methods heretofore employed will be discarded, and the cost of various ores in treatment or conversion into metal, especially Lead, Zinc and Silver Ores, Nickel, Cobalt and Copper, greatly reduced. All the matte of the latter, which was heretofore sent to Germany, is now being refined in the United States. **THE HARTSFELD GERMAN MINING SYNDICATE, of NEWPORT, KY.,** invites correspondence. (See their advertisement)

RARE CHANCE FOR COLONISTS.

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